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THE BURNED CITY HALL.



PATERSON'S GREAT FIRE—THE CENTER OF THE BURNED DISTRICT.

THE PATERSON FIRE.

THE business portion of Paterson, N. J., was reduced to ruins by a most disastrous fire which occurred early Sunday morning, February 9. The fire broke out in the car shops of the trolley company in lower Broadway. A high wind fanned the flames into a fierce blaze, so that by the time the firemen reached the scene the fire was beyond their control, and in twelve hours it cut a swath, a mile long, through the business section of the city. The damage was not far from ten million dollars, making it the most disastrous fire which ever occurred in the State of New Jersey. The flames swept from block to block with amazing rapidity, destroying banks, churches, clubhouses, stores and dwellings. Among the public buildings burned were the City Hall, Public Library, the old City Hall, the police station, engine house and schools. Five hundred houses were destroyed, and it is estimated that a thousand families were rendered homeless. The firemen were powerless to cope with such a conflagration. Calls for aid were sent to the Fire Departments of Newark, Passaic, Rutherford, Ridgewood, Hoboken, Montclair and surrounding small places. These calls were promptly responded to, but their efforts were unavailing. The fire went over the city in leaps, starting in many separate places, the high wind carrying enormous volumes of sparks for blocks and causing fires to start on the roofs, so that the firemen could not distribute themselves properly, and places were allowed to burn down. Soon the spaces between these places closed up in the heart of the city, and the great mass of flame swept on, unchecked, following the course of the wind. The swath was over two blocks wide. Families living in many of the houses were obliged to flee for their lives, and their sufferings were intense. Paterson's famous "white square," composed of fine bank buildings surrounding the City Hall, soon became one roaring furnace, and the City Hall, with its many valuable documents, was completely gutted. Fortunately the large factories and mills which are the life of this busy manufacturing town were not injured, so that many thousands who would otherwise have been thrown out of employment were not disturbed.

COMMERCIAL ASPECTS OF ROMAN LIFE.

By HROLF WISBY.

In ancient Rome it was considered a crime to be poor. It would be difficult to find a better proof of the esteem in which capital was held by the Romans, and their idolatry of wealth for wealth's sake. The origin of Roman wealth was the Roman triumphs, which paved the way for commercial enterprise on a hitherto unprecedented scale.

It cannot be denied that the political system of the time was characterized by the regardlessness and selfishness of the moneyed classes, which rose to power supreme almost as rapidly as the great middle class disappeared and mingled with the wretched plebeian element. "A good watch dog," says a Roman writer on economics, "must not be on too friendly terms with his 'fellow slaves.'" The slave and the ox were treated on the same level, and they were cared for from no other reason than that it would have been costly to let them starve; both alike were sold when their usefulness as slaving animals ceased, because it would have been bad economy to keep them.

Nevertheless, with all the grave faults of Roman rule, in spite of the barbarity and inhumanity of many of the strongest Roman institutions, the mercantile spirit expanded with every triumph of the Caesars, so that when Rome was at the height of her military glory she had also become the great commercial center of the world at the time. The position of the Eternal City toward the ancient world may be compared to the position of London toward the modern world, in so far that Rome was the controlling center of the money market. The parallel does not hold good when we begin to compare the trade of Rome with that of London, for Rome did not figure as an export city at all, merely confining herself to a vast, disproportionate import trade drawn from the numerous shipping ports of her domain. Right here we pick up the thread that shall guide us to a true understanding of the element in Roman business life which encouraged the founding of mercantile associations and developed commercial gatherings on an international scale of attendance.

A DISGRACE TO ACCEPT MONEY FOR WORK.

When we wish to know why Rome did not export we must penetrate to the core of Roman society, and there we find the true obstacle in the shape of an apparently harmless local custom invented by the patricians. It originated with the idea that it was disgraceful for a man of standing to accept money for work. However desirable such a custom might be if introduced into certain phases of our national political system, it produced a much more harmful effect on Roman life than the capitalist system, pure and simple, could have done.

First of all, it shattered the bonds of civil equality, broadened the gulf between the rich and the poor, and established a plutocracy the like of which the world has never seen. It raised social barriers everywhere, not merely between the laborer or the artisan and the landlord or the manufacturer, but also between the army officers and the military tribunes, and between the courtiers and the magistrate. Such barriers exist to-day in a modified shape throughout Europe, but during Roman rule they were so high and so forbidding that the most productive branches of business were abandoned—because it was considered disgraceful to work for money. This principle made it possible for the rich man to lord it over his fellows, and it became a sin to be poor. It forced the poor man into slavery, the army or the public manual service, and the manufacturer and the tradesman, who, in spite of some means, could not afford to do work for nothing, were driven out of existence. The capitalist system reacted on agriculture and the various branches of industry and commerce with such sweeping force that the home trade fell into decay in preference to the dealing in money and the farming of the public revenues, which really formed the mainstay of the Roman State. The chief productive sources of the country were paralyzed, and

instead of free labor Rome had brought upon herself the curse of slave labor. Historians record eight guilds of craftsmen which were among the institutions existing in Rome from time immemorial, and which were recruited from the ranks of freemen until slave labor was substituted. There were the goldsmiths, the coppersmiths, the carpenters, the potters, the dyers, the fullers, the flute blowers and the shoemakers, a list substantially covering the class of tradesmen working to order for others in the very early times, when the spinning of bread, the art of healing the sick and the spinning of wool into garments were not known as professions. The importance of these craftsmen guilds ceased when slave labor was substituted, and all handicraft was looked down upon and despised.

We have seen how this idea of disgrace by money getting, a mere whim of the patricians, practically revolutionized Roman life at a time when it was vital to maintain the national productive sources. It is true that commerce flourished, but it is no less true that it was confined to importing what Rome needed and could not herself produce. Rome had nothing to sell except money. The most serious consequence of the decay of the national industries, notably agriculture, which has always been the chief resource of Italy, was the difficulty experienced by the Roman State in supplying adequate food supplies to the multitude. If the small farmer, the tradesman and the artisan had continued to exist; in fact, if the freedom of the Roman citizen had been preserved, the empire would undoubtedly have been able to raise its own supplies, and the home industries might have increased to such an extent as to form an item of export. But Rome converted herself into a vast military camp in which the commanding officers were capitalists and the soldiers were slaves, and consequently the burden of supplying grain, pork, wine and oil fell upon the commanding officers. How perilous any failure in this direction might be to the peace of the city and the safety of the officers is well illustrated by the letters of Symmachus covering this matter. Serfdom on such a large scale, as contrasted with the healthy competition of free labor, naturally encouraged the import trade at the expense of the exports, but the historical reason for this condition of affairs remains, curiously enough, a patrician whim.

VOCATION COMPULSORY.

To truly understand ancient Roman commercial life we must not lose sight of the fact that toward the close of the empire a strong effort was made to prevent a free circulation among the various callings and trades of life, and to keep the multitude penned in according to a system of social caste similar to that of India. Men were compelled to follow the same trade or occupation as their fathers, whether or no they liked it. Those engaged as sailors in bringing the grain from Africa to the public stores; those working as bakers, turning the flour into loaves for the populace; the butchers who brought pigs from Samnium, Lucania or Bruttium, the purveyors of wine and oil, the stokers who fed the furnaces at the public baths, were compulsorily bound to their vocation and denied the liberty of choosing a profession. It was the principle of rural serfdom applied to the multitudes of Rome, and it gradually absorbed every element in Roman society, except the capitalists, in one great national slavery. The object of the caste system was to keep people of various classes from making combinations against the wealthy, and while the Roman State was successful, as a rule, in averting plebeian uprisings, it was finally obliged, after centuries of supreme sovereignty, to yield to the foreign invaders. In their anxiety to pen in the populace the capitalists lost sight of the fact that they were at the same time enfeebled the people, robbing it of its former national pride and patriotism, and only too late did they discover that from such people could not be drawn the kind of Roman soldier that made the legions of Julius Caesar famous. Public esteem of the military service, at one time boundless, began to decline as soon as slaves were substituted for freemen, and toward the close of the fourth century it was detected so strongly that the increase of self-mutilation to escape conscription had to be checked by the most severe punishment.

With this social basis in our mind, we may proceed to consider the more distinctly commercial aspects of Roman life, and its development in bodies and gatherings for the regulation and promotion of mercantile interests.

ROMAN WEALTH.

Roman wealth, of which so much has been written, was not so very remarkable for magnitude as for endurance. In this respect it forms a curious contrast to American wealth, which is truly remarkable for its magnitude, and which must continue for several centuries to come before we can begin to compare it with that of Rome as to endurance. We are much richer than the Romans, but it remains to be seen if we shall stay rich as long as they. Although Lucius Paulus, with an estate of 60 talents, or \$70,000, did not figure as a wealthy Senator, we know that the value of \$100,000 was considered the beginning of riches in ancient Rome. Five times this amount was a princely fortune, and only those in high office, and such as had been governors of wealthy provinces, lorded it over millions. But money brought in more in those days, and luxuries could be had for a song on account of the instrumentality of the slaves.

When the mercantile spirit began to make itself felt in earnest, it emanated as the spirit of the capitalist, and as such it pierced and permeated nearly every station and department of social life. Even the pursuit of agriculture and the government of internal affairs became game for the capitalists. A species of mercantile morality, which disengaged as squandering all forms of giving away without recompense, seems to have settled down into the conscience of the Roman people, and even legislation was obliged to yield to it. Thus the giving of presents and bequests, and the undertaking of securities, were subjected to restrictions by decree of the burgesses, and heritages if not claimed by the nearest relative were regularly taxed. The idea of an inheritance tax seems also to have occurred to the Roman mind. Another form of mercantile morality, which was undoubtedly the most useful in establishing Roman virtue before the intervention of slavery, was that which made respectability, honor and

punctuality the three essential requirements of the business man. Every citizen was morally bound to keep an account book of his income and expenditure. In every well-conducted household there was, accordingly, a separate account chamber (tablinum), and every one took care not to die without having made a will. Those household books were admitted as valid evidence in any Roman court of justice, just as the merchant's ledger of to-day may serve a similar purpose. The conventional respectability of the Roman business world was particularly noticeable in the gradual but strict enforcement of the rule that no respectable man should allow himself to be paid for his services. What this rule, incorporated as a principle and pushed to its last extremity as an element in society, brought about we have already mentioned. Suffice it to add that magistrates, officers, jurymen, guardians, and in general all respectable men intrusted with public functions, refused to accept recompense for their services and confined themselves merely to compensation for their outlays. This was the only pleasing and socially useful aspect of this otherwise ludicrous rule.

COMMERCIAL ASSOCIATIONS.

One of the most far-reaching results of the Roman business spirit was the extraordinary encouragement given, sometimes by the very nature of the capitalist system, to the formation on an extensive scale of commercial associations. In Rome these institutions were primarily suggested by the system of the government in employing middlemen for the transaction of its business. Considering the scope of the deals it was natural, as well as expedient for the sake of maximum security, that the capitalists should undertake such leases and contracts, not as individuals, but in partnership with several other parties of responsibility. Indications point to the existence among the Romans of the feature so characteristic of the modern business world—namely, the consolidation of rival companies to jointly establish trade monopolies for the control of the output and the selling price. It was customary for business men belonging to the same associations and dealing in the same product to put their heads together and form what we would call a joint stock company, into the treasury of which each member would pay his share, outsiders being excluded. If there were twelve members in the syndicate the stock was owned exclusively between them, and the profits were pocketed by them. There was no attempt to "float" the market, and there does not seem to have existed any market in stocks in ancient Rome, in spite of the great development in the money lending and general banking business. Accordingly such anomalies as "watered" stock were unknown, and as there were no subscriptions so was there no public interest manifested in the various syndicates, which conducted their business behind closed doors, or rather portières.

THE SYNDICATE SYSTEM.

In transactions involving considerable risks, especially transmarine shipping, the syndicate system was so extensively adopted that it practically took the place of business insurance, which was, however, unknown to antiquity as an institution. Probably the most common and stupendous of these insurance schemes was the so-called nautical loan, through the agency of which the risk and profit of transmarine shipping were proportionally distributed among the owners of the vessel and the cargo and the capitalists advancing money for the voyage. The rule followed by the Roman capitalists was less liable to ruin them than the methods adopted in our business world, for the Roman economists held that it was advisable to take small shares in many speculations rather than speculate independently for large stakes. Cato advised his business associates not to fit out a single vessel for his money, but in concert with forty-nine other capitalists to construct fifty ships and take an interest in each to the extent of one-fiftieth part or share. Naturally this introduced hitherto unknown complications in the matter of keeping accounts, but the Roman merchant successfully overcame this obstacle through his punctuality and close attention to detail, and besides he possessed in his system of management by freemen and slaves a far more preferable machine, from the point of view of the ancient merchant, than our counting-house system. These various mercantile associations and companies exerted a strong influence on Roman economy, private as well as national. To quote the words of Polybius, there was hardly a Roman citizen of means who had not been involved as an avowed or silent partner in leasing the public revenues, and it was common for capitalists to invest the majority of their fortunes in shares bought from the various commercial associations.

CONTRACTORS' COMPANIES.

During Rome's greatness the transactions of her merchants fully kept pace with the contemporary development of political power. Closely connected with the business of money lending was the institution of the contractors' system. Capitalists belonging to various associations got together and formed separate contractors' companies to take over and carry out the various municipal national contracts. This was done to a much larger extent than is the case with the leasing of public contracts in this country, which is noted for turning over more enterprises for private speculation than any European government. Bids were opened not only for building and construction undertakings, but for harvesting the national crops, for grinding the same into flour and for supplying the city of Rome with provisions of certain specified kinds.

It is not to be supposed that the remarkably developed commercial system of Rome, vast in proportions and subtle in detail compared to the business standards of antiquity, should have lacked permanent meeting places for the gathering of capitalists similarly interested in trade. In fact, several Roman writers of note tell us plainly that such places and such gatherings were as common as market fairs, and possibly by reason of their frequent occurrence no writer has seemed to think it worth his while to make a record of them. That these gatherings were often of international importance has been fully demonstrated by the evidence of Roman historians, and we

know that members of gatherings of congresses, etc., but of the empire for them, masses could originally be of the before the subsequent part of the proportions of capitalists a commerce. Perhaps the fairs, that places for the shadow on the plain.

Such fairs they reached the reign of out according involved, antiquity to became the venue for the promulgation of gatherings was hired increased were erected commercial. So, while administration in no existed, no, only as also utilized foreign and mercantile evidence more numerous the judicial Roman, most notable mercantile in a certain degree of ancient trade information the goods factories in a crude the world.

The inscriptions in any other Roman country the summer of public roads the different rapid. As the railways importance imagined, gathering international Rome issued of these named after Appia—was the Pontic roads for the main road to Messina which, C. 100 B.C. shipping roads of nation road to Illyria and Antioch, Eastern.

This road system moving the rate, and stimulus of these roads to 100 miles frequent the weather influence. Thus, while a journey of days, it couriers distance were, as the average stances.

Historical development of the commercial which was to the extent. Ancient chronicles they have internal affairs is only facts, historical international of the

know that not infrequently the number of attending members was so large and so representative that the gatherings assumed the significance of commercial congresses, involving not only local and national interests, but also conditions in the conquered provinces of the empire. Long before such gatherings ascended to real prominence religious festivals paved the way for them. The idea of getting together in great masses could not be carried out without business in some shape ensuing from it. Thus the great annual assembly before the temple of Voltumna in Etruria was originally a religious festival, but gradually business interests began to manifest themselves, and the attention of the assembly became diverted between worship before the temple and trading at the fair that was subsequently held at the same place. The business part of the Voltumna festival gradually assumed such proportions, and such was the increase of Roman capitalists in attendance, that it was in fact more of a commercial congress than a religious assembly. Perhaps the most important of all the ancient Italian fairs, that gradually became international meeting places for traders the world over, was that held under the shadow of Mount Soracte, in the grove of Feronia, on the plain of the Tiber.

ROMAN FAIRS.

Such fairs were generally named "mercati," and they reached their highest development in Italy during the reign of the Caesars. In Rome the fairs branched out according to the nature of the principal business involved, and there also we find the first attempt of antiquity to separate the fair from the congress. It became the rule for commercial associations to convene for the purpose of discussing their interests and promulgating future business policy. At first these gatherings took place at some court or forum, which was hired for the occasion, but as the transactions increased in magnitude special buildings, or *fora*, were erected for the permanent use of the various commercial congresses, to which the property belonged. So, while a *forum* was originally a place for the administration of justice, another class of *fora* crept into existence in Rome, and these buildings served not only as meeting places for the merchants, but were also utilized for the exhibition of samples of both foreign and domestic merchandise. The latest historical evidence points to the conclusion that the *fora commercia* (mercati), or the commercial *fora*, were more numerous than the so-called *fora judicia*, or the judicial *fora*, of which the greatest, the Forum Romanum, still remains, next to the Coliseum, the most notable ruin of ancient Rome. The *fora commercia* at their highest development may, to a certain degree, be regarded as the commercial museums of ancient Rome. In any event they supplied the trade information then obtainable, and by exhibiting the goods from abroad as well as domestic manufactures they exerted a similar influence, necessarily in a crude way, on the business life of the Romans as the commercial museums exert on the modern business world.

THE INFLUENCE OF GOOD ROADS.

The instrumentality of good roads aided more than any other factor in the growth and importance of the Roman commercial forum. When the empire was at the summit of its glory it was intersected by a system of public highways which rendered intercourse between the different parts of Europe easy and comparatively rapid. As the public roads took the place of telegraphs, railways and steamboat service in those days, the importance of such a system of highways can be imagined, and without them the Roman commercial gatherings would not have been able to assume an international character. From three separate gates of Rome issued three great main roads. The most famous of these was the magnificent highway built by and named after Emperor Appius Claudius—namely, Via Appia—which ascended the Alban hills and ran across the Pontine marshes to Capua, where it divided into roads for Northern Italy and Europe. The second main road led to Reggio, and thence by ferry to Messina and the principal cities of Sicily, one of which, Capo di Boco, was the regular port of winter shipping for Carthage, in Africa. From Carthage roads of Roman construction led westward in communication with Spain and eastward to Asia. By a third road it was possible to reach Turkey, Macedonia, Illyria and Thrace, connecting with Athens and Antioch, which latter city was then the center of Eastern trade.

This magnificent system of skillfully constructed roads proved of immense advantage to the Romans in moving their armies with hitherto unexampled swiftness, the mails were transmitted at a much quicker rate, and trade with distant provinces received a great stimulus to renewed increase on a large scale. The speed of the Roman government couriers in traversing these roads was much accelerated by the institution of relays, and the service was so well conducted that the average speed for long distance rides was increased to 100 miles per day. Much better speed was not infrequently made, but the conditions of the roads and the weather during the travel sometimes necessarily influenced the progress of the couriers a great deal. Thus, while Caesar is credited with having covered his journey of 769 miles from Rome to the Rhone in eight days, it was not an unusual accomplishment for good couriers to speed from Antioch to Constantinople, a distance of 747 miles, in six days. Private letters were, as a rule, conveyed by good runners, making on the average 25 miles a day under favorable circumstances.

Historical accounts as to the further commercial development of the Roman State are wanting; in fact, the commercial and agricultural aspects of Roman life, which were the main pillars of Roman wealth, belong to the element of which we know exceedingly little. Ancient historians appear to have been so busy with chronicling the dates of wars and revolutions that they have omitted to leave a reliable account of internal affairs pertaining to the main industries. It is only here and there that we happen upon a few facts, jotted down as on the impulse of the native historians, which reveal that something of actual international commercial importance was going on most of the time.

THE SILK INDUSTRY.

Thus we know that the silk industry, which was destined to become paramount in Italy, was promoted at the direct instance of the Emperor Justinian, and we know that this would scarcely have occurred were it not for the excellent roads connecting the Roman Empire with the East. As Justinian reigned only as Byzantine Emperor, during the period 527 to 565, governing his provinces from the imperial seat in Constantinople, the art of silk spinning was not brought directly to Rome, but owing to the commercial interchange between the two metropoli the art finally found its way also to the Eternal City. Justinian ordered the silkworm of China introduced for the exclusive purpose of furnishing himself and his court with the envied garments of the Chinese, but if some commercial forum of the Rome before his time had taken up the matter it is likely that the business instinct of the emissaries would also have induced them to introduce in Rome the art of paper making and printing as conducted in China, whereby much valuable literature would have been saved. As it was, Justinian contented himself by dispatching two Persian monks to the land of the celestials, from which they returned with the eggs of the silkworm in a hollow cane. The eggs were hatched out in cow manure, the worms were set to spinning on the leaves of the Byzantine mulberry, and Justinian got the fine clothes of his choice. The opportunity to introduce the priceless art of printing on paper was not taken advantage of, and the Chinese kept the secret that, if revealed then to the Western world, would doubtless have changed many a page of history as we know it.

It is hardly necessary to extract additional historical evidence to emphasize the fact that the ancients recognized the benefits accruing from commercial gatherings, and utilized the international character of the assemblies attending the fairs and the religious festivals for business purposes. Local events show that analogous conditions existed in a modified shape in Babylonia, in various cities of the Greek realm, and during the middle ages a similar commercial system was in evidence, now in one city, now in another, most prominent in the centers of greatest activity and business importance.—*The Iron Age.*

COLOR IN WATER.

In the beginning of the discussion the importance of distinguishing between color and turbidity was pointed out, but it was also stated that the true color or vegetable stain due to substances in solution is not always a practical limit to the amount of color which must be taken into consideration. This is because many surface waters contain suspended matter of organic origin in amounts too small to be measured as turbidity, although sufficient to affect the color.

The true coloring matter is derived primarily from decayed vegetation; it is usually brownish, but may vary in hue from greenish-yellow to reddish-brown. It has been known for a long time that in an unpolluted water the amount of nitrogen as albuminoid ammonia and the amount of carbon as represented by the oxygen consumed were proportional to the amount of coloring matter within certain limits. In a general way the amount of iron increases with the color, and under certain conditions iron plays an important part in the production of the color. Ground waters, for example, are often colored by ferric oxide, but inasmuch as this is largely in suspension the color produced is more properly classed as colored turbidity. The color which water acquires at the bottom of a deep pond is likewise due to a great extent to the presence of compounds of iron.

The platinum-cobalt standard suggested by Mr. Allen Hazen is considered the standard of color measurement. According to this standard as originally devised, the color was measured in terms of the amount of platinum in parts per 10,000 which, in acid solution, with so much cobalt as matched, produced an equal color in distilled water. Mr. Whipple believed that it would be a decided advantage to make the unit of color equal to the amount of platinum in parts per million rather than in parts per ten thousand, in order that the figures which represent the color may be whole numbers rather than decimals and in order that the determination may fall into line with the present tendency to express the results of analysis in parts per million. He used this method throughout his discussion.

The amount of coloring matter in a surface water depends chiefly on the character of the vegetation on the watershed and on the length of time the water remains in contact with the organic matter. If the water is collected from a rocky watershed having steep slopes and but few trees the color will ordinarily be below 20; from wooded or cultivated areas with steep slopes, from 20 to 50; from wooded or cultivated areas with gentle slopes, from 50 to 100; from areas having numerous swamps, from 100 to 500 or more. In general it may be said that high-colored waters are most common in the Northern States. South of the glacial drift line many of the streams carry clay which tends to reduce the amount of coloring matter in solution, in a manner described at some length in Mr. Whipple's discussion. The amount of color is subject to seasonal variations, being a minimum in the Northern States during the winter. Ground water is usually colorless or nearly so, but wells sunk in swamp areas may yield a high-colored water under certain conditions, which were explained.

The color of water in large lakes is seldom high, for three influences are at work to produce this result—dilution, precipitation and the bleaching action of sunlight. Such large lakes receive water from a catchment area which varies in its character, so that the high-colored waters are diluted by others low in color, and, during low stages of the lake, colorless ground water may also exert a diluting effect. The second influence, precipitation, is not great, yet experiments have shown that even where there is no evident turbidity, surface waters from swamps often contain enough finely divided suspended organic matter to affect the color; this matter will settle to the bottom if the water is kept standing. The most important influence in decolorization is the bleaching action of the

sunlight. This has been known for some time and has been studied in Massachusetts with much painstaking care. Mr. Whipple stated that he was convinced from experiments that the bleaching action at the surface was considerable, but that it decreased more or less rapidly with increasing depth, according to the color of the stored water. In very dark waters the bleaching action is probably confined to a layer at the surface not over 1 foot thick, but as the water becomes lighter the action takes place at greater depths.

It will sometimes be more economical to prevent surface waters from acquiring color than to decolorize them later. To do so the color from each division of the watershed must be studied, and steps may then be taken to drain the swamps and to intercept the water of low color from upland districts and lead it into the streams without allowing it to enter the swamps. Reference was made to the excellent results attained by Mr. FitzGerald on the Metropolitan reservoirs in this way. The removal of organic matter from the bottoms of reservoirs is another method of reducing color.

Filtration through quartz sand has absolutely no effect on the coloring matter in water, although it may slightly reduce the apparent color by removing finely divided organic matter in suspension. The clay usually present in filter beds may also produce a slight decolorization.

Generally speaking, the water must be changed chemically before the coloring matter can be removed. Sulphate of alumina is commonly employed for this purpose. According to the accepted theory the sulphate is decomposed by the carbonates present in the water, with the formation of sulphates of the alkaline earths in place of their carbonates and of aluminium hydrate. If the carbonates present are insufficient to decompose all the aluminium sulphate added, the hardness of the water must be artificially increased in order that no undecomposed coagulant may remain in the water. Experiments made by Mr. Whipple have, nevertheless, shown that so far as decolorization alone is concerned an increase in hardness is undesirable and, further, that the complete absence of carbonates is favorable to economical decolorization. He described some interesting tests which support this contention.

While the reactions of the aluminium sulphate with the carbonates and the coloring matter take place simultaneously, their relative importance in decolorization varies according to the alkalinity of the water and according to the rapidity with which the coagulant is mixed with the water. Two bottles of clear water which had a color of 100 but no alkalinity were treated with 0.8 grain per gallon of aluminium sulphate. The first was shaken immediately, while the second was allowed to stand one hour before shaking. At the end of 24 hours both samples were decolorized. Two bottles of clear water which had a color of 100 but an alkalinity of 50 parts per million, were similarly treated with two grains of aluminium sulphate per gallon. After 24 hours the sample which was shaken was decolorized, while the other was not. To the latter it was necessary to add three grains per gallon before the color was removed. It is evident, then, that for economical decolorization, provision should be made for rapidly mixing the applied chemical with the water so that it may come in contact with the organic matter before it has all changed to hydrate.

The direct reaction between the aluminium sulphate and the coloring matter has another bearing on the coagulation of waters which Mr. Whipple discussed at some length. Mr. George W. Fuller found at Louisville that the theoretical amount of reduction of alkalinity by the addition of a certain amount of aluminium sulphate was seldom obtained in practice. This he attributed chiefly to an absorption of the chemical by the suspended matter in the water, and Mr. Whipple believes that the coloring matter also absorbs a certain amount of chemicals, though not in just the same manner. For example, when one grain per gallon was used to decolorize a water which had a color of 75, the reduction of alkalinity was but 84 per cent of the theoretical amount. In this case the coagulant was not lost, of course, as it was doing useful work in precipitating the coloring matter, but inasmuch as the precipitate formed by this reaction has been found by experiment to be far less efficient in coagulating the suspended matter than in aluminium hydrate, it follows that more coagulant is required to clarify a colored water than one without color.

Mr. Allen Hazen said that the question of decolorization was a wholly aesthetic one. Color could be removed by coagulating the coloring matters or by oxidizing them, although the first method was the only one in practical use to-day to any extent. For the second method ozone and permanganate seemed the best agents to use, but further studies were needed. Mr. George A. Soper stated that color was largely due to the imperfect oxidation of the organic matter in water. If it is attempted to remove the color by adding oxidizing agents, the process has to be watched very carefully to prevent the use of an excess of the agent, which must be removed by some further treatment. Ozone is the most promising agent, although it is generally used to sterilize water, for which purpose about six milligrammes per liter are employed. Mr. George W. Fuller said that decolorization was growing in importance because it would enable good supplies deficient only in the matter of color, to be used in place of more expensive supplies of clear water. The works at Norfolk, Va., described in *The Engineering Record* of May 19, 1900, were mentioned as an example of this. In a general way it might be assumed that 2 to 2½ grammes of sulphate of alumina were needed to remove a color of 100, but some waters required more. With the water from some deep wells at New Orleans, for example, a much greater amount was required.

German Measures Against Tuberculosis.—Consul-General Mason sends from Berlin translation of an explanatory leaflet concerning the prevention and treatment of tubercular disease, issued for popular information by the Imperial Health Office of Germany. A copy of this leaflet was transmitted to the Marine-Hospital Service, and has been printed in *Public Health Reports*, vol. xvi, No. 48, November 29, 1901.

THE DAVID COPPER PROCESS.

ALTHOUGH the metallurgy of copper has advanced during recent years, further simplifications appear desirable in several respects, and so far the often-attempted adaptation of the Bessemer process to copper had failed. It is noteworthy that in the very year when Bessemer succeeded in making steel direct from pig it occurred to several metallurgists to treat copper matte in a converter in a similar manner. Among the earliest patents which aimed at this direct production of copper we may mention those of Gassage, Baggs and Keates, and many other names could be quoted. Holway, it may be remembered, at any rate succeeded in obtaining a white matte. Most of the other attempts ended in practical failures, and the Royal Institution of London agreed that the converter did not appear to be suited for turning out metallic copper.

It had, however, been introduced into copper works, but without sufficient modification to yield practical results. A decided transformation was required. The converter had preserved its well-known shape of a cylindrical recipient with vertical or horizontal axis, and a system of lateral tuyeres, admitting the air blast at a slight depth below the surface of the metallic bath. Of this kind was a Bessemer apparatus for the metallurgy of copper, patented in 1880 by Mr. Manhès, a French engineer. The process was adopted or tried in the Egguilles Smelting Works, near Sorques, in the Department Vaucluse. The managing director of these works was Mr. David, the inventor of the characteristic novel process which we will presently describe. On the Manhès plan, the ores were first smelted to matte in furnaces; the liquid matte was then introduced into the converter, and the blast turned on; under abundant evolutions of sulphurous acid vapors, the metallic copper began to collect in the lower

sway, especially not with low-grade mattes. In their case the operation had to be repeated. The first blast had to produce a superior matte of 60 or 75 per cent, which had then to be subjected to a second treatment. For as the tuyeres were stationary, care had to be taken that a sufficient amount of metal was always covering the lower portion of the converter, so that the unreduced matte should be raised to the proper level within the blast zone.

Mr. David therefore constructed a horizontal cylindrical converter whose tuyeres formed a cylindrical generatrix. That arrangement permitted of changing the level of the nozzles during one and the same operation, so that the cold air struck only the matte, but neither the metallic copper nor the slags. This proved successful within limits. As long as the ores were free of certain constituents, notably antimony and arsenic, a good copper was obtained; but with their presence a mechanically inferior copper resulted. As now these very constituents are characteristic of auriferous and argentiferous copper ores, something better had to be found, not to lose these valuable by-products, which the practical metallurgist cannot waste.

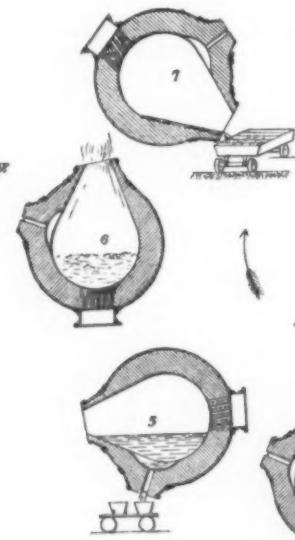
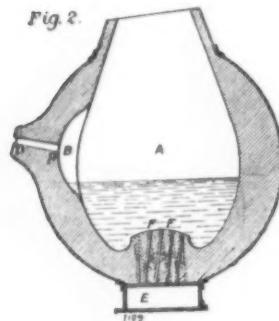
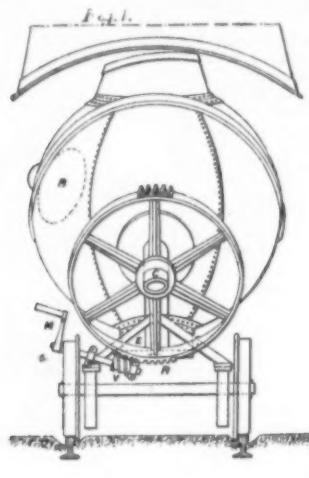
The solution of this difficult problem has been found in the special converter which Mr. David distinguishes by the term "selector." The principle is that of the extra process of the Welsh smelting works. When a complex sulphide ore, containing nickel, antimony, etc., is being oxidized, the reduction should proceed in the inverse order of the affinities of the different metals for sulphur, which we know form their heat of combination with sulphur. That is to say, gold should first be reduced, and copper last. As a matter of fact, of course, the process does not follow such simple lines. Copper is continuously reduced; but when we fractionate this copper as it is being formed, we find in the first portion all the gold, together with a little of the antimony; in the second all the antimony, to

lar care. It comprises a flexible steel tube which can take up the concussions of the converter due to the agitation of the heavy liquids and solids, and is packed with leather. The tuyeres do not project into the interior, nor is there any need for keeping them open by special means, as they are inclined and grouped like generatrices of a hyperboloid. Under the influence of the oblique currents issuing from the air passages, the whole mass assumes a gyrating motion, and the matte, thrown obliquely against the wall of the converter, sinks down again. This brisk gyration of the mass keeps the air passages unobstructed, as already pointed out, and clearing is only required at the beginning of the operation, when the mass is still cool; but the converter need only be inclined for this object.

Recently Mr. David has considerably simplified the construction of the selector pocket, which will occupy the lowest position of the selector, when the vessel is inclined the opposite way in which it is held for pouring out the charge. The rather complicated pocket above described is now reduced to a truncated cone, from the smaller base of which the discharge passage starts. Clay is rammed into this passage to close it, and the passage is reopened with the aid of a steel rod.

The selector rests on a frame of U-shape and turns about a hollow axis when passing through the different operations of a cycle. The diagram, Fig. 1, explains the mechanism. The worm which engages with the toothed wheel fixed on the hollow shaft is turned by a crank. The whole converter travels with four wheels on two rails, and can thus be brought up to the smelting furnace to receive its charge and returned to its position under the chimney hood, which takes up the fumes; these fumes pass through condensing chambers before they escape into the atmosphere.

The rammed refractory lining is an agglomerate of quartz and a little clay; it is dried with the aid of



THE DAVID COPPER PROCESS.

part of the converter. A copper with 1.5 per cent of impurities resulted, which could easily be refined. In the United States, where converters are applied on a grand scale, experiments have been made with lower pressure blasts, and particular attention has also been paid to the preservation of the converter lining, which is subject to rapid corrosion; sand and silicious minerals have been injected through the blast pipes, and basic linings have been tried.

Mr. David, the director of the Egguilles Works, had all the more reason to devote his ingenuity to the improvement of the copper converters, as he has to deal with raw material of extremely varied types. As a rule, the converter copper is both auriferous and argentiferous; but refining in a reverberatory furnace does not eliminate all the substances which are likely afterward to disturb the electrolytic separation. For this reason particularly he gave the practice of the Welsh smelting works a trial. In Wales, the impurities of the metal are concentrated in the "bottoms" of comparatively low density, which are separately treated in a reverberatory furnace. It occurred to the inventor to produce these bottoms directly in the converter. In countries where fuel is expensive, the converter is more economical than the smelting furnace, and the task was to produce, in one operation, both the bottoms and a purified copper in its metallic state.

Success, it need hardly be stated, was attained only after a large number of more or less fruitless experiments. Mr. David first had the idea of fixing the tuyeres horizontally at a certain level above the bottom of the converter, with the object of confining the blast to the matte; while the metallic copper would sink to the lower space beneath the tuyeres as it was being reduced from the matte. The metallic copper would thus not be exposed to the cold blast, and not tend to cool rapidly. Unfortunately, this apparatus did not an-

gether with other metals; and finally, we draw off pure copper containing only a little silver. Chemical analysis of a mineral will tell us how much copper we must separate by the first fractionation in order to make sure of removing all the elements which impoverish the copper.

The David selector allows of repeating this separation as many times as we desire without interrupting the process, and thus exposing the fused matte to cooling. The selector is made spherical for various reasons. The spherical form combines the greatest capacity for a shell of a certain area with the greatest strength; the fireproof lining can best be applied, and will wear uniformly. The converter is a sheet-iron retort lined with refractory earth, and provided with a mouth, through which it is both charged and discharged, and which further serves as an outlet for the gases. The box, also of sheet iron, for the tuyeres is fixed into the lower portion of the selector. The air arrives through the axis, C, and through the curved conduit, D (Fig. 3), on which the gearing for turning the converter is mounted. The bottom of the box, E, is provided with orifices; a perforator is passed through the holes to force air passages through the lining in the proper direction. The level of the nozzles lies a little higher than the bottom of the vessel. To the one side of the converter is fixed, by means of bolts which can easily be removed, a spherical dome, also made in sheet iron and lined like the whole converter. This dome forms a pocket which communicates—or communicates, for a simple construction is now applied—with the interior of the vessel by a passage. There are two openings in the pocket. Through the first it is cleaned and the port is opened or closed; through the second opening, at a lower level, the metal is discharged. These manipulations are carried out with the help of the gear, R (Fig. 1).

The joint with the air-supply pipe requires particu-

three or four coke stoves, which heat the mass to red glow and convert it into a fireproof covering.

The following lines briefly describe the various operations of the process, which are indicated in the seven diagrams of Fig. 5. The minerals or mineral mixtures, to which suitable fluxes are added, are brought into the furnace; the flux is of the ordinary kind, calcareous or siliceous, according to the nature of the gangue. The whole mass melts, the sulphides sink to the bottom, and the slags float on the top. The slag is tapped off at intervals of 20 minutes, and finally the metallic sulphides—the mattes—are run off into the mouth of the selector through an inclined conduit of sheet iron, protected by a fireproof lining. When the selector is full, the tap-hole is closed, and the conduit withdrawn. This is the first operation.

For the second phase the selector is returned to its normal position under the chimney, and the flexible air pipe is attached. The reactions commence immediately. Clouds of white fumes escape; they consist of sulphur dioxide and of the volatile oxides of metals like zinc, lead, etc. The iron combines with the silica of the lining to a basic silicate. This silicate is very fluid, and floats on the matte; its formation and its oxidation are powerful sources of heat. The temperature rises rapidly during the first stages from 500 deg. to 1,500 deg. C. and the mass soon becomes white hot, in spite of the cold blast passing through the fluid. The heat is not due to the sulphur, for as soon as the sulphur begins to be burned, the temperature goes down. It is the silicate which binds the oxygen, and one might indeed say that the iron plays the part of the fuel, and acts as combustible. This view is quite in accord with recent researches on the combustion of metals. Soon the sulphides of the other metals (not copper) will be oxidized, and the fumes become brighter; the flame, originally a transparent red, due to the combustion of iron sulphide, turns into a light

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blue. At this moment only iron silicate and copper sulphide will be left in the selector, which must then be emptied without delay. For otherwise the liquid would boil over and be ejected from the converter; a tumultuous seething gives timely warning.

We come to the third phase, the pouring-off of the slag. This slag, which is white hot and liquid like water, is removed by tilting the selector, and received in cast-iron pots, running on two wheels. The operation must be conducted with care not to allow the copper sulphide to pass out the same time. To watch it, a spatulum of iron is dipped into the iron slag, and as soon as the first drops of white matte are noticed, the selector is tilted back, and the fourth phase commences. The point is now to reduce the sulphide of copper, and, first of all, the other sulphides still present in it. The blast is turned on again. After five or ten minutes, a certain weight of copper will have been reduced; it will contain all the gold and also the other metals which have not been volatilized during the first operation. The selector is again tilted, but in the opposite direction this time; so that the fused mass collects in and over the pocket. A few ingot molds are brought up to the pocket, and the taphole is pierced. The heaviest mass, or bottoms, will flow out first. When it is observed that the fused matte begins to follow, the orifice is quickly stopped up again, a stick of wood, long enough to reach the pocket, being fixed as a core to the tamping. This wood afterward becomes carbonized, and facilitates the reopening of the pocket. We have thus come to the end of the fifth phase of Fig. 5. The blast is turned on once more.

During this last stage, the flames issuing from the mouth of the selector have reassumed a red color, which deepens as the reduction proceeds. At the same time, however, the temperature diminishes, and by the time the reaction is finished, the flame has almost disappeared, and only the brilliant "copper rain," known to metallurgists, remains. The copper has to be poured into the ingot molds (7), and when this has been done, and the selector has been brought back to its vertical position, a new cycle of operations can at once be entered upon. No preheating of the selector will be required. Broadly, it may therefore be said that the selector operates like a converter. But there is the important difference in favor of the selector that the products are fractionated without interfering with the reduction or interrupting the continuity of the process. The short duration of the phases and the continuity of the process spare the lining, and that means an important saving in materials and in labor.

The inventor emphasizes a further particular advantage of his process, which is very interesting and important for the metallurgy of precious metals. As the gold which the mineral contains will be concentrated in the first portion of the reduced copper, this portion can profitably be electrolyzed to separate the gold from the other substances. A small percentage is very common to copper ores, and hitherto that gold was mostly lost, as it could not economically be isolated. If we imagine a 10 per cent copper ore, containing only a tenth of a gramme of gold per 100 grammes of ore, the ton of copper resulting from this ore will yield 10 grammes of gold, and the David selector enables us to recover the gold at small cost—about 30 francs per 3,000 francs of gold—simply because this gold was concentrated in the "bottoms." The electrolysis will, moreover, proceed in a more regular and uniform way than when we have to deal with the whole copper, and the bath will last much longer if we base our estimate on the value of the gold recovered. There is a further point worth mentioning. If we line the selector with an auriferous quartz, that gold would also pass into the copper bottoms, while the silica is rendered useful in forming iron silicate. We could thus utilize a quartz too poor in gold to justify its extraction, without incurring any supplementary expense.

As regards the crucial question—the economy of the novel process—we may refer to the results obtained at Eguilles, where the David selector has first been put to practical work. The Eguilles Works belong to the Société des Cuivres de France. The time occupied by a cycle of operations will naturally depend upon the grade, the purity, and the weight of the mass dealt with. That time is one of the most essential items for

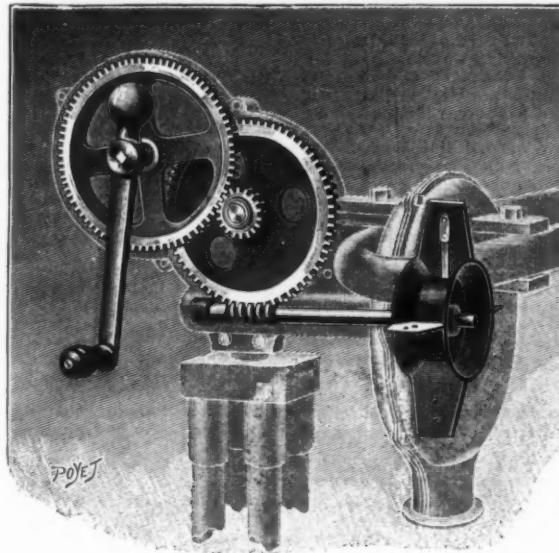
the valuation of the process is evident; for an impure and poor matte, grading 30 or 35 per cent of copper, the cycle of operations will, in an apparatus of a capacity of 1,500 kilogrammes, be completed within 60 or 80 minutes. Of this time we have to reckon from 15 to 25 minutes for the formation of the iron silicate slag; 5 or 10 minutes for the formation of the bottoms; 20 or 25 minutes for the reduction of the purified matte. Under these conditions 10 or 12 and from 15 to 20 tons of matte can be dealt with in a day of 24 hours. With a matte of 55 or 60 per cent, the period would be reduced to 40 minutes, and about 30 tons of matte could be reduced per day with a selector of the same capacity. As regards expense, the Eguilles Works produce a ton of copper, calculating average wages and average prices of raw materials, at a cost of 21.7 francs (17.4s.). This sum includes 4.171 francs for lining (both materials and labor); 7.47 francs for blast; 4.50 francs operating expenses proper; and the rest for maintenance and diverse expenditure. It is estimated, on the other hand, that the production of a ton of copper on the old converter system would cost 40.50 francs, allowing 8.47 francs for general attendance, 9.83 francs for lining the converter, and 11.28 francs

the London Engineering for the engraving and description.

AN INGENIOUS FORGE BLOWER.

WE illustrate herewith, from *La Nature*, a forge blower of which all the arrangements are well elaborated, and the setting in operation of which is said to be as easy as the performance is satisfactory. The apparatus is operated by means of a winch balanced by a counterpoise and which actuates a toothed wheel that gears with a spur wheel keyed upon the axle, and which itself carries teeth that engage with a worm gear fixed upon the axle of the blower. The air drawn in from the exterior is forced toward the furnace of the forge and so much the better in that the use of gearing permits of revolving the blower at a high velocity. The loss by friction is very feeble, in the first place, because the gearings are machine worked, and, in the second, because the bearings are ball ones. The arrangement of these bearings is quite peculiar, since the balls are mounted in a steel cage that revolves with them and holds them close together.

The gearings are inclosed in a dustproof box that



A NEW FORGE BLOWER.

for supplying the air. These figures suggest a great saving, even with a selector of small capacity and with comparatively inferior ore. It is manifest that keeping the air passages clear will be a large item in the working expenses. The passages of the old converters have constantly to be cleaned and opened, but the selector does not give any trouble in this respect. The preparation and maintenance of the fireproof linings are also more economical, because the lining wears away uniformly, and does not peel off on exposed portions, as in the old converters.

We must not forget, however, that "bottoms" can also be produced in other furnaces, in reverberatory or in blast furnaces. In the latter case, however, the "bottoms" will be less pure and contain iron. The reverberatory furnace is no doubt better in this respect. But it consumes a large amount of fuel, and it requires well-trained attendants. Further, the "bottoms" might remain in a pasty condition, owing to low temperature, and then flow out with the purified matte, so that the latter has subsequently to be reduced in another apparatus.

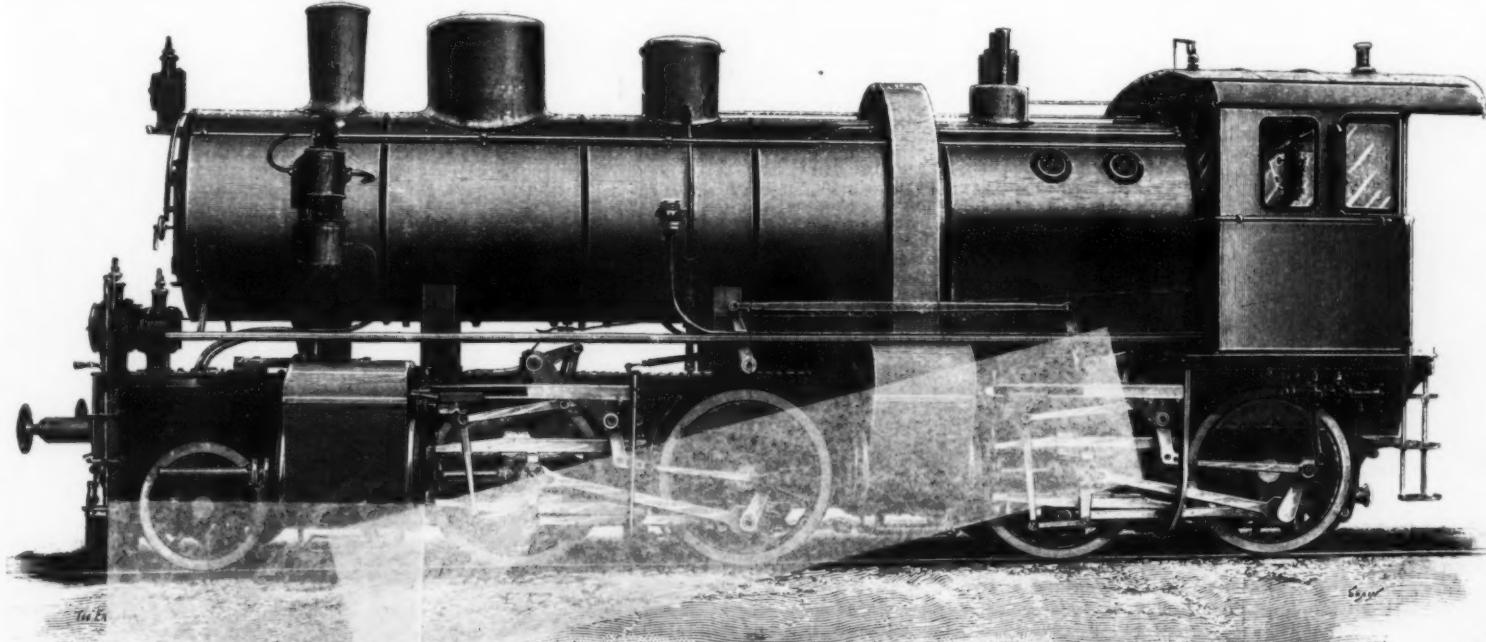
Taking all these points into consideration, the David selector may be regarded as a very interesting metallurgical novelty, destined apparently to play an important part in the copper industry.—We are indebted to

forms an oil bath. The parts apt to wear are of phosphor bronze or tool steel, and, finally, the entire apparatus with its accessories does not weigh quite a hundred pounds.

COMPOUND LOCOMOTIVE, BULGARIAN STATE RAILWAYS.

THE necessity for employing heavier and more powerful locomotives on existing railway tracks without awaiting the replacement of light rails by others of heavier section or of reconstructing curves of short radius, has led, on the Continent, to the adoption of various systems of locomotives having the weight distributed from four to eight driving axles divided into two independent groups, each worked by a separate set of engines in such a way that the rigid wheel base is shortened by one-half; while, in other arrangements, the engines are not duplicated, but have a suitable play in the driving mechanism connecting the two independent groups of wheels; or, in yet other cases, certain of the axles—curiously constructed—permit a longitudinal radial motion to the coupled wheels—all of which attain the same end in diminishing the resistance on curves.

Best known of these is the Mallet system, employed,



COMPOUND LOCOMOTIVE, MALLETT SYSTEM, BULGARIAN STATE RAILWAYS.

as it is in France and its Colonies, in Germany, Hungary, Spain, Russia, Sweden, and Switzerland. Of the other arrangements we propose to make reference at another time. The locomotive illustrated in this issue was one of the finest examples of mechanical work among the number built on the Mallet compound principle, that were sent from various countries to the recent Paris Exposition.

Although, like the Fairlie engine, this type of locomotive was originally designed for narrow gage, or for new railways with light rails and short curves, it has, in its development, found a wider sphere of service on regular main lines and the broader gage railways, where the engine loads were beginning to exceed those for which the line was intended. Thus, out of some 450 engines about 55 per cent are employed in the latter capacity, and of these a large number have calculated tractive efforts of from 10 to 14 tons. The locomotive we illustrate, No. 2096 of the builders, and classed B B III, on the Bulgarian State Railways, is, however, one of medium power only — 11.1 tons

($p = \frac{d^3 l}{D}$) as compared with the tank engine of the

Belgian State Railways, with its 3,083 square feet of heating surface, adhesion of 108 tons for driving, and tractive effort of 16.7 tons.

Concerning the Mallet compound locomotive arrangement in general, it will be merely necessary to remind the reader that the driving wheels are divided into two groups, and that the two frames of each group are jointed together by a hinge. The rear group is driven by the high-pressure pair of cylinders, the exhaust therefrom being conveyed forward to the low-pressure group by a single central pipe between the frames, provided near to the axis of the bogie pin with a flexible coupling pipe, and which, on account of the low pressure of the first exhaust, it is comparatively easy to make and maintain steam-tight. As the only part of the locomotive susceptible to lateral displacement is the front end of the bogie, with its engines, the forward end of the boiler has to be carried upon a saddle, which permits, under its seating, a free play to the supporting bogie. The exhaust pipe from the low-pressure cylinders is, for the same reason, provided with spherical joints at the cylinder end and beneath the blast pipe. Beyond these two principal boiler connections, all minor attachments to the front truck are either flexible or allow for play. *For our engravings and the foregoing particulars we are indebted to The Engineer.*

NAVAL DEVELOPMENT DURING THE NEXT DECADE.

By Rear Admiral GEORGE W. MELVILLE, Engineer-in-Chief of the United States Navy.

PROGRAM. The four most significant events in the nation's history during the past decade have been the satisfactory solution of the financial question, our remarkable industrial expansion, the acquisition of the Philippines and the rapid development of the navy. Not only our own thoughtful people, but also our continental neighbors have been impressed with our action in these matters, and as a result our relative military and industrial standing has greatly advanced.

Our progress in securing the front rank in financial credit; our ability to hold the home market as well as to successfully compete in the foreign field; our rapid colonial extension, and our success in virtually obtaining the command of the waters of North America, have forced us into a position as a World Power.

It is not only our right to extend our trade, but it is our duty to prevent foreign markets from being unjustly taken away. We must never forget, however, that prosperity and success produce rivals and incite the jealous to opposition. They, therefore, bring new responsibilities, and it is certain that in order to hold on to what we have secured through conquest or industrial superiority we must maintain an armed force of sufficient strength to manifest our readiness and ability to protect commercial rights and privileges.

Only by right, and not by might, will this nation fulfill her highest destiny. For all time the thought should be dispelled that increased material prosperity can be maintained by conquest. It should ever be kept in mind, however, that those countries which are rich in natural resources, but wherein there is no martial spirit, are always the objects of attack and conquest. It is as essential to be in readiness to restrain by military and naval forces the foes that are beyond the boundaries of a country as it is to effectively control, by a local police, the turbulent within a community.

In this age of strenuous life and action war can only be averted by those nations which are in condition to resist aggression. The best guarantee for peace is military strength and preparedness. Our environments are such that no nation would dare to attack us except from the sea, and, therefore, the navy must constitute the first line of defense from a foe. We don't constitute a navy great enough to attack the coast of any Continental Power, but we do require a fleet of battleships that could quickly prevent an enemy reaching our shores. Since the navy should be too large rather than too small, it should be regarded as a weapon rather than a shield, for the exigency might arise when it would be necessary to seek the enemy's shores. If maintained to a strength sufficient to be used only as a shield, it would not be long before the navy might be compelled to retreat from its position offshore and seek the shelter of the harbor batteries.

The question of the development of sea power has always been an attractive one. There is a wonder and romance to the sea which makes everything pertaining to the ocean of absorbing interest. The element of danger is never removed from those who go down to the sea in ships, and as the scene is ever changing, the subject is always of interest. It will be remembered that the navy has always kept in close touch with the people, and has never been used in the suppression of liberty. Despotic as may be the organization of the individual warship, there is a spirit pervading the service that keeps the navy in sympathy with the purpose of the great mass of the community. Life on the deep is a busy, stirring and invigorating one, and the spirit of

unrest and anarchy has never secured a firm footing in any naval service.

With each succeeding year new and powerful forces are arrayed in favor of increasing the navy. It is inevitable that there will be a progressive and rapid development of the naval organization during the next decade. By briefly mentioning some of the elements that are back of the movement to advance our relative naval strength one can best realize how certain we are to advance in standing as a sea power.

Probably the strongest force arrayed in behalf of a greater service is the attitude and action of the general press. Fortunately for the interests of the nation the question of increasing the navy is not a political one. Its augmentation is urged as vigorously in the South as it is in the North. In demanding that the complement of war ships be increased the people of the Pacific coast are as enthusiastic on the question as those living on the Atlantic. It is a happy coincidence that there is a keen desire everywhere for information relating to the construction, organization and use of the battleship. Many writers now find the subject a profitable field for the employment of their literary talent, since there is a commercial value to news pertaining to the naval service. The several thousand daily papers and the hundreds of magazines and periodicals are almost a unit in urging the Congress to give more men and more ships to the service. The press is, therefore, a mighty force in working for a larger navy.

The subject meets with such approval that it is now an interesting and leading topic of the lecture field. By means of lantern slides and interesting descriptions of warships addresses upon the navy are exceedingly popular. The warships themselves are also powerful educators in influencing public sentiment as to the necessity for an increased naval establishment. It is safe to say that during the past four years hundreds of thousands of visitors have been shown over the battleships and have been told of our naval needs and necessities.

There are a dozen naval stations and navy yards which are centers of influence for creating an interest in the organization. The mechanics at these stations have allied themselves with organized labor, and as a result the Congress of the United States receives hundreds of earnest and powerful petitions urging the construction of warships at the navy yards. At least ten shipbuilding firms in this country can build battleships and armored cruisers, and some of these establishments have a literary bureau for creating public interest in warship construction. Over fifty firms can build gunboats, and hundreds can manufacture naval stores and supplies. All these firms have a selfish, if not a patriotic interest in the enlargement of our fleet, and in the past these forces have been quite powerful factors in helping us to secure more war vessels.

The army of tourists and commercial travelers who annually visit Europe return to America strong believers in a larger navy. The influence of these classes is very great, and has made itself felt upon this question in the halls of Congress. The commercial and maritime associations of the leading seaports have also done effective work in aiding us to secure a larger navy. These organizations have correspondents in every section of the country, and the indirect aid extended has been greatly appreciated. The shipping interests particularly are interested in the movement, for the friends of the merchant marine fully understand that a fleet of battleships paves the way for the formation of a line of merchant steamers.

As to the attitude of the administrative officers of the government upon this question, every Secretary of the Navy and President for the past twenty years has urged the progressive development of this branch of the military service. They have personally visited the ships, and also urged the creation of a naval reserve. The annual appropriation for the naval service has gradually increased, till now it is over double and nearly treble what it was five years ago. For the next fiscal year, including public works of a naval character, Secretary Long has submitted estimates calling for an appropriation of practically \$100,000,000. The Secretary has been an extremely conservative administrator, and the naval needs must have been very urgent, otherwise he would not have recommended an appropriation of such character. The President has indorsed in its entirety the budget submitted by Secretary Long. There has been no Chief Executive whose knowledge of naval affairs has been so thorough as that possessed by Mr. Roosevelt, for only a few years after leaving college he wrote a naval history of the war of 1812 that has long been regarded as one of the best upon the subject. His appointment as Assistant Secretary of the Navy was, therefore, to his particular liking, and while in that office he learned fully of our needs. If the estimates submitted by Mr. Long had been in any way excessive the matter would hardly have escaped the attention of the President.

The naval estimates have been received with such favor that it is exceedingly probable that the Congress will even increase the appropriations urged by the Navy Department.

It is neither wise nor necessary to set our standard of naval strength by that of any other power. No nation should be regarded as a probable foe, but all are commercial rivals. The history of the world shows that every commercial rival is also a possible foe, for nations will rush to arms in defense of maritime and commercial rights sooner than they will for almost any other cause.

One need not possess a great military mind to realize that now we are in possession of the Philippines, it will be near those islands where we shall have to fight our future decisive battles. It is there of necessity where we are weak, and it will take many years to strongly intrench ourselves in that locality. There is already a cry of "Asia for the Asiatics." It is certain that we must eventually renounce all sovereignty of the Philippines or else prepare ourselves to hold these islands against an efficient naval power whose base of operation may be much nearer than our own. It is a fact that once a nation acquires territory the flag is never hauled down except at a loss of military prestige and commercial influence. We are going to maintain a protectorate over this littoral beyond the Pacific for some time, and a strong navy is the first requisite of this responsibility and duty. We should establish in some harbor in the Philippines large engineering

shops, where machinery could not only be built and repaired, but where warships could be docked and built. For the past three years the private docks in China and Japan have been reaping a financial harvest in the repair of our ships, and military reasons demand that we should not continue to strengthen these establishments in this way.

The defense of the Philippines is but one of the many reasons why we should have an increased naval establishment. Within ten years an interoceanic canal connecting the Atlantic and Pacific oceans should be well under way, and no matter at what point it is cut it will require a strong navy to insure its safety and neutrality when completed. Such a canal is a military necessity, even though the final cost should run up into the hundreds of millions. Such a canal would help guarantee peace, since it would permit us to move our fleets quickly from coast to coast. It will be a paying investment in the end to do the work. The canal can certainly be built for half what it has cost England to overcome the Boers. Anything, therefore, which will avert war is worth paying for.

We are bound to advance in relative naval strength, for it is more than probable that before the end of the decade we shall rank next to England as a seagoing power. Some exigency may compel us to suddenly increase our naval strength, and if industrial and commercial reasons justify the purchase of steamship lines, it may be pertinent to ask why we may not be compelled to make a wholesale purchase of warships from some nation that has greater temporary need of gold coin than steel guns. Just previous to the Spanish-American war we were ready to purchase anything in the shape of war material that could be bought, and it is not at all improbable that some of the surplus millions in the Treasury may go to the purchase of foreign warships. It may be that there is no precedent for such action. This nation, however, is going to care less for what has been than for what may be. To maintain its position as a dominant world power it will make precedent. The financial condition of several countries is such that they will have to dispose of some of their most promising assets, and it may be that we can make for the peace of the world by suddenly augmenting our naval strength in this manner.

Progressive development will not only be made in the direction of building more ships, but advance will take place along the line of making each vessel more formidable. Improvement will be evidenced everywhere, but in several particular respects marked progress will be noted.

There will be a noticeable gain in the speed construction of warships. Up to the present time it has taken five years to design and build a warship, for in no instance has the modern battleship been commissioned in less than five years from the time she was authorized. Since several of the navy yards are now in condition to build the largest type of warship, the private firms are going to be spurred on to faster work in the completion of war vessels. Unless individual establishments expedite the construction of naval work, the government may undertake the task of building its own warships. The nation which is superior in speed construction possesses an important military advantage, and with our great resources we should be second to no nation in this respect.

The progressive improvement that has been made in the character of armor will continue. We have two establishments which can turn out armor of all descriptions, and there is every prospect that at an early day a third firm will compete for this work. It can also be expected that not only will the capacity of the plants be enlarged, but that means will be found for making the armor more rapidly. It should also be possible to fit the armor to the hull more simply and expeditiously, and this will assist in lessening the time of speed construction.

It is highly probable that there will be a change in the size of the main battery of the warships. The large gun has had its day. There is no evidence that any material damage was done to any Spanish warships at the battle of Santiago by our 12-inch guns. In that engagement the conditions for using large guns were exceptionally favorable. The 12-inch gun is too heavy, long and cumbersome for existing needs. It is to be hoped that we will take the initiative in designing a battleship whose main battery is not over 10 inches. The 10-inch weapon of to-day is capable of more effect than the 12-inch gun of five years ago, and this is due to the fact that we now possess a safer and more powerful explosive, a more reliable breech mechanism and a handler gun mount. As it is not likely that heavier armor will be placed on board the warship, and as the gun has always kept in advance of armor, we can secure the best arrangement of battery by the installation of smaller weapons.

There is a phase of the armor and gun controversy that has not yet been investigated to the satisfaction of naval engineers, although these expert officers have called attention to its importance. I refer to the indirect damage that will be wrought by the impact of every 8-inch or larger shell upon striking the armor belt. There are at least one hundred separate steam cylinders or motors on every warship. There are miles of piping and electric conduits. There are scores of bearings and supporting brackets for piping. There are innumerable joints of various descriptions, also many electric junction boxes. The impact of several good-sized shells upon the armor protecting the machinery compartments will undoubtedly put out of use some important auxiliaries. It will not be necessary for the shell to explode within the vessel to put the warship out of action, for the shock transmitted by the projectile striking the armor will cause some machine of importance to the fighting efficiency of the vessel to be seriously impaired.

Structural and machinery steel will withstand strain and pressure, but it will not resist shock. The impact of the projectile upon the armor will be transmitted to a greater distance than is anticipated. It is more than probable that the most serious damage inflicted will be found in compartments other than in those whose armor has been hit. Damage will not only be done to the auxiliary connections, but it is extremely probable that some sections of the hull riveting will be greatly impaired. Experience has already shown

that these rivets can be easily sheared by shock. If the hull armor of any warship gets much pounding from 8-inch or 10-inch shells it may not be necessary for the projectile to burst within the ship to cause the vessel to sink, for rivets will be sheared, seams will be opened, and possibly the outboard valve chambers loosened. In short, the naval engineer of to-day is much more concerned as to what will be the indirect rather than the direct damage inflicted by modern ordnance upon striking the armor of a modern battleship.

By reason of reducing the weight of the battery and armor, there will be opportunity afforded to increase the efficiency and reliability of the propelling and auxiliary machinery. By making some of these parts heavier the liability to accident and derangement will be greatly lessened. The use of electricity will be extended, particularly for motors which do not require much power. It can be expected that the steam turbine will be successfully installed in small gunboats and torpedo-boats. An approved type of water tube boiler and an economical installation of engines of American design will have been adopted, and thus it will be possible for the future battleship to steam much more efficiently. The use of such steam generators will also permit the vessels to get up steam more quickly, and thereby increase the fighting efficiency of the ship. The standardization of auxiliaries will have been accomplished, and, therefore, the fleet will be more self-sustaining in regard to repairs.

The triple screw will be in general use in all strong navies, for economic, structural and tactical reasons will compel its adoption in warships.

It can also be expected that a satisfactory system will be devised for burning crude petroleum with economy and reliability. The burning of this incomparable fuel will be so perfected that it will be possible, when necessity arises, to force the combustion from 50 to 75 per cent, thus giving the commander of the warship the power to obtain maximum speed in very short time.

Even in the direction of the personnel will there be an improvement. Ever since the beginning of a steam navy there has been a tendency to demand increased intelligence and skill from every one attached to a warship. It was recently remarked by a very capable and distinguished British naval captain that drunkenness has decreased in the naval service proportionately to the enlargement of the machinery plant. In explanation of this statement he said that no commanding officer would rest content to go to sea with a dissipated crew, particularly if their duties related to the machinery portion of the vessel. With this higher skill has come higher pay, and thus a better class of men is progressively being secured.—Philadelphia Record.

AERIAL NAVIGATION PROBLEMS.

THE preconclusive and condemnatory article of Rear-Admiral Melville on the "Problem of Aerial Navigation" in the December North American Review demands reply, inasmuch as the Problems of Aerial Navigation are many, and not one single "Problem," any more than are the many solved and unsolved problems of marine navigation; and to speak of the Problem of Marine Navigation or of the Problem of Aerial Navigation is equally unjust and misleading.

The scientific weight of that article, admirable as it may be in a strictly literary or imaginative sense, is typified by the opening quotation from Shakespeare—a "tale of dreams," "as thin of substance as the air," a masquerade of purely speculative fancy in the garb of a combatant. As a target for attack the article consists mostly of a wide area of circumscribing field and little of central bull's-eye, or practical illustration of pertinent facts to aim at; while to facts I must confine myself, as an aeronautical engineer, experienced in my vocation, and carefully considering the views of a marine engineer deemed competent within his sphere, yet who is not within his sphere of actual knowledge or personal observation when he enters that of aerodynamics, a new science, to be investigated persistently and candidly, and not assailed untimely.

It would seem less strange for an aeronaut to review marine craft from aloft, and even submarine craft, which through optical laws can from a balloon be well inspected upon the surface of the sea and when submerged beneath it, than for a marine engineer to offer his limited view of aerial craft as conclusive knowledge, when not based on personal experience of their aerial-sea-going qualities.

That preconceptions of conditions and a weight of authority falsely based on admitted knowledge of the winds and waves on sea, should of themselves force conclusions as to navigation of the air, and annul the belief of aeronauts basing faith on actual experience, seems an evil only to be avoided by a firm denial of adverse preconclusions, and a true representation of facts as they really appear in the actual practice of the art aeronautic.

Confining myself to what seems the bull's-eye of Rear-Admiral Melville's remarks, the gas balloon of M. Santos-Dumont, I quote his preface on it:

"A calm survey of certain phenomena leads the engineer to pronounce all confident prophesies at this time for future success as wholly unwarranted, if not absurd.

"M. Santos-Dumont can without doubt round the Eiffel Tower and return to St. Cloud on a calm day, but no actual trial is needed to show that such journey is impossible on many days, is always exceedingly dangerous, and of little or no practical use. The difficulty and danger are due, as has often been shown, to the inability of the balloon to retain its shape."

Considering, if you please, that as the result of constructing several successive airships, each one defective, but an improvement on its predecessors, M. Santos-Dumont finally traveled between three and four miles with the wind, and returned an equal distance against it, and landed at his place of departure within thirty minutes total time, and thereby won a prize of \$20,000 offered for this feat, why should now a marine engineer characterize this progress in a new sort of air navigation as "always extremely dangerous" and of "no practical use," and hopes and predictions based upon it "absurd"?

During none of M. Santos-Dumont's many trial trips was he in any way injured or unnerved. Of all the many balloon races, in flocks or fleets, starting from Paris within the year and landing hundreds or thousands of miles away, with air craft monstrous in size compared with the Santos-Dumont vessels, there were no "killed or wounded." But these were balloons, "open at the bottom."

"Closing a balloon at the bottom," says Melville, "and maintaining a slight pressure within it is more promising. Hydrogen, which is the most buoyant gas available for inflation, under a pressure of ten pounds per square foot loses only about one-half of one per cent of its buoyancy, and the balloon could resist the normal pressure of wind blowing at the rate of twenty-five miles per hour. The fabric of such a balloon twenty feet in diameter would, however, have to sustain a tension of not less than seventeen pounds per running inch."

I say it would not, in practice. The severest test any balloon can sustain is under the varying strain of wind when at anchor in a storm. During twenty-three years' experience I have had hydrogen balloons of just twenty feet in diameter anchored in whatever wind presented itself on a day selected weeks in advance; and I have safely held a captive balloon of thirty feet diameter anchored without shelter on the open Rockland County Fair Ground near New York, where it survived the recoil of the storm which wrecked and submerged Galveston, Texas, in 1900, and created great havoc in New York State, city, and bay. All these balloons were constructed of one thickness only of the finest, thinnest cotton cloth known. Their safety lay in the elasticity and resistance of their contained hydrogen, on which the storms beat in vain.

No one without due experience with this peculiar gas can have any just estimate of its marvelous qualities for aeronautical constructions. Under normal conditions with a common balloon it sustains "unconsciously" the crushing strain of the earth's atmosphere, or about fifteen pounds upon every square inch of balloon surface, or about one million seven hundred and fifteen thousand pounds on a globe of twenty feet diameter. What bears this strain? Not the balloon envelope, but the hydrogen. De Bausett's "vacuum airship," which could not be successfully braced against this crushing atmospheric pressure by any other material on earth and still remain light enough to raise itself, could easily have survived construction and operation if braced with hydrogen gas. It is a chimera without it. But to go on:

"And here we are met with a new difficulty; for unless the pressure within the balloon is limited by means of a safety valve, the tension of the fabric will be increased nearly fourteen pounds for each hundred feet of ascent."

Well, suppose it is. Suppose also that a safety valve, or other means, relieves it. M. Santos-Dumont's airship had such a valve, and right-minded airships usually do, while ordinary balloons discharge gas automatically from open necks, as they have occasion, and never know they are suffering. On the other hand, I have tied the open mouth of a distended cotton balloon of twenty feet diameter tight shut, and gone up a mile at higher.

"If," says Melville, "the heavier fabric required by the closed balloon becomes heavier as we increase the size of the balloon," it does not "place it at a disadvantage," for the larger balloon, while doubling its diameter and squaring its surface area, cubes its bulk and buoyancy and may well sustain eight-fold weight.

Thus a globe of commercial hydrogen sixteen feet diameter, with surface area 804 square feet, bulk 2,145 cubic feet, and buoyancy 134 pounds, would, if of 32 feet, or double former diameter, have 3,217 square feet surface, or four times its former area, and a bulk of 17,157 cubic feet and a buoyancy of 1,072 pounds instead of 134 pounds as previously. Consequently, a model of reduced size labors under many disadvantages, and gains strength and power by great strides as it increases size.

As for the balloon "to carry sufficient propelling power to enable it to remain stationary in a wind blowing thirty-five miles an hour," I am confident that it will appear whenever there is a sufficient inducement, just as the balloon of M. Santos-Dumont appeared when there was an inducement for it to sail at the rate of sixteen miles per hour.

To construct a thirty-five mile airship would certainly cost much less money than needed to construct any marine vessel to increase a former speed of sixteen miles per hour to thirty-five. It seems to me that these possibilities are much nearer realization with aerial warships than with marine ironclads, except in the one matter of demand, which inspires supply.

Rear-Admiral Melville says: "Ways and means having been decided upon, it will be manifest that one particular size has an advantage over all others."

Why? It may be demonstrated that one form may be best, but why one size? "Certain phenomena," he adds, "such as frictional resistance of the air, make for a larger size." This may mean that if we double the diameter of the airship we thereby multiply the surface and surface resistance by four only, while we multiply bulk and buoyancy by eight; but how about that other resistance to headway, termed "head resistance"? I regret that Rear-Admiral Melville did not cover this objectionable feature of both marine and aerial navigation exhaustively, as it is regarded by many engineers as lying at the root of the whole matter, and is esteemed by some as the greatest opponent to increased speed in airships, and marine vessels as well. However, if we place four chambers of equal diameter in line, we thereby retain the resisting cross-sectional area of the same diameter as before, instead of quadrupling it, as with doubled diameter; and yet we have quadrupled buoyancy with some increase of frictional resistance in water and only little in air, the headway resistance being unchanged.

I look upon this objectionable feature of headway resistance more seriously, and the elimination of aerial resistance has occupied nearly all my aeronautical life, and resulted in reasonable, not to say abundant success.

It is obvious now that some form may be better than another, as for piercing like a needle, for cutting like a razor, for biting like a cold-chisel, for indenting like

a modern projectile, or for cleaving air like a proper airship. The action of the projectile and the propelled airship being somewhat kindred, except in velocity and weight, I early sought the only technical information available in works on gunnery, and found the tables and estimates to vary greatly in theory and practice. Thus, where the resistance of a disk was theoretically 228, experimentally it was 285; when hemispherical on the rear side, it was still 288. When hemispherical on the front or advancing side, it was theoretically 144 and experimentally 119; when spherical, it was theoretically 144 and experimentally 124. The cone, with point advancing, was in theory 53, in practice 166. With disk advancing, it was theoretically 288 and experimentally 291. In another case it was given as 100 and 100, in theory and practice, when the base of the cone advanced; but with the point of the cone advancing, the resistance was theoretically 25 and experimentally 52. The semi-ellipse was theoretically 50 and experimentally 43. The ogival or arch-pointed projectile was theoretically 41 and experimentally 39.

These apparent results, both in theory and experiment, varied so irregularly and uncertainly that I resolved to find out something for myself, which method of obtaining knowledge has several features to recommend it. As the required velocities of airships were less than those of projectiles, I built a spring gun, whose recoil could have an unvarying force, or could be increased or decreased according to scale. From this I discharged rods tipped with all known forms of projectiles and many new ones, of equal weight, capacity and sectional area, at various angles into air, water, snow, sand and ice. The results were very curious, and I threw away all my previously acquired information and sought to unravel the mystery of a new form, which I termed aerolite. This form I modified and built as small balloons of various lengths and types, having the same cross-sectional area and buoyancy when filled hard with mixtures of air and hydrogen to exactly float or poise. These balloons were anchored in winds of different velocities, or towed head on attached to spring scales marking the drift or resistance, with still more curious results, revealing something like a new principle in aerial translation.

This body apparently defies the assumed laws of aerial resistance to headway passage. If constructed strictly in accordance with the maximum speed to be attained, as the speed of translation and the flowing curves of ebb and flow or recoil of air on surfaces have an intimate relation. I have never succeeded in achieving an exact formula for estimating the cubical contents of this body, and have to depend on the approximate "rule of thumb" or experimental practice in construction. In all the larger practicable vessels I have taken much experimental liberty in modifying the form to test it, especially during some forty consecutive days in September and October, 1900, when I navigated it as a dirigible airship four times daily during thirty-minute periods, within the St. Louis, Mo., Coliseum.

The vessel was propelled by a screw with a combined hand and foot power, like a bicycle, so that the effort of the rider to produce motion was a significant evidence to him of the aerial resistance encountered. At first both ends of the airships were blunted or rounded by constricting netting till the form was egg-shaped. In this state, to drive it around the aerial arena above a walk in speed was a test of endurance, and after a half hour's evolutions the gearing was too hot to bear a hand on it, or to retain lubricating oil, so that frequent rests and cooling were necessary.

Gradually, day by day, improvement in form resulted from freeing first the prow and finally the stern, with ever-increasing speed, less effort, and reduced temperature of gearing and rider. When the prow was clear there was no longer heat or fatigue, though constant effort was necessary to retain speed. When the stern was also clear there was neither fatigue nor effort, while double effort doubled speed, and produced cumulative results if continued, so that speed had to be checked because narrow space and many obstructions made navigation dangerous, as the vessel was sixteen feet diameter and thirty-nine feet long when equipped with its tips fore and aft, which had to be removed, leaving the ends rounded, to shorten and avoid collisions.

Alternating with these bicycle airship trips were four daily tours, of thirty minutes each, by a smaller model, thirteen feet long, of varying type, driven by a very light electric motor, governed by an operator stationed at a distant switchboard. This gas vessel was of the thinnest, frailest silk to be found. It had nine coats of varnish applied by machinery and four by hand brushes. It was crowded full and hard with hydrogen, almost to the point of bursting like a bladder, and it endured the changing temperature, varying with freezing outside and steam heat within, and crowds of ten thousand to twenty thousand, without injury. Its "boat" beneath was hung simply from a keel of silk attached along its belly. It remained rigid in form at any speed. It averaged six miles, by anemometer carried, during each thirty-minute tour, four times each day, or about seven hundred and twenty miles during five weeks, while describing every evolution of any bird, with frequent stops and reversals.

It is pertinent to say something farther here in answer to the statement of Rear-Admiral Melville that the mysteries of an airship of able design "could not be kept a secret when it reached the point of practical application in war."

This electrical aerial torpedo was a model dynamite vessel. It was operated openly in the presence of hundreds of thousands of people, many of whom minutely observed the vessel and its controlling switch, within touch from the open boxes. It has since been inspected at my home by many visitors from this and foreign lands who came especially to see it, and none of whom has ever ventured an explanation of the system by which it was managed in free aerial evolutions. It is still open to inspection as an unopened "secret."

Regarding its usefulness as a war vessel, Mr. W. J. Atkinson, General Manager of the St. Louis, Mo., Exposition of 1900, says in a letter to me at the close of that exposition: "You clearly showed in the flight of your electrical aerial torpedo as great control with as wide a radius of flight as is now obtained by the best type of submarine controlled torpedo."

"Either of these airships, in their present state of development, in the hands of a man skilled in their use and willing to take less than the ordinary risks of warfare, could destroy any battleship or fortification in existence." The *italics* are mine.

"It seems to me that the application of a motor developing great power with limited weight would enable you to construct your sky-cycle on a larger scale and give you a commercially successful airship." These are the views of an experienced man of business, an observer of the vessels many times daily during five consecutive weeks. Fourteen months have since elapsed. Meanwhile these vessels have improved.

"But," Rear-Admiral Melville says, "the worst thing that could happen would be a partial success for aerial navigation, in which case it would have all the insidious evil of a half-truth, and be a commercial counterfeit, susceptible of endless circulation."

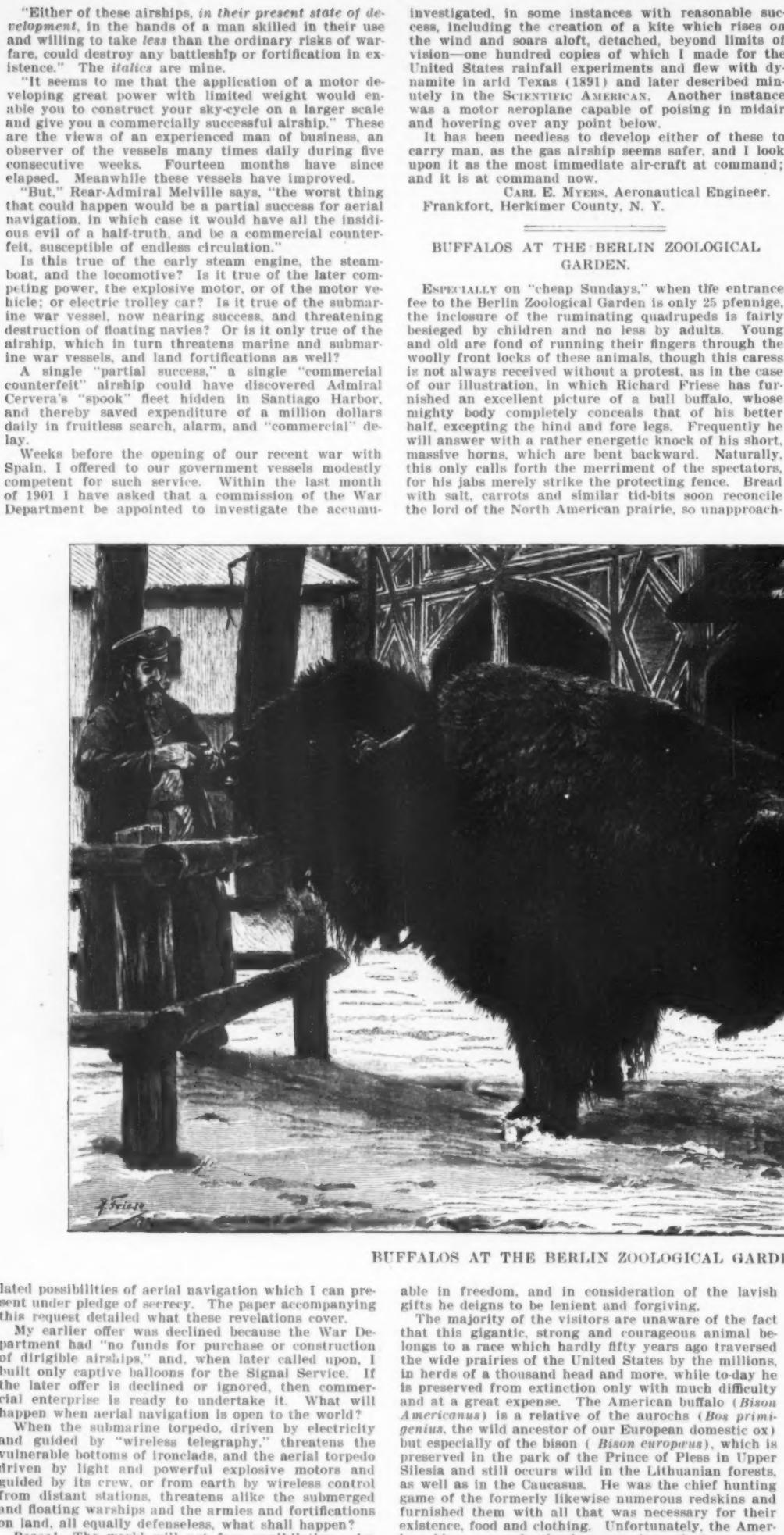
Is this true of the early steam engine, the steam-boat, and the locomotive? Is it true of the later competing power, the explosive motor, or of the motor vehicle; or electric trolley car? Is it true of the submarine war vessel, now nearing success, and threatening destruction of floating navies? Or is it only true of the airship, which in turn threatens marine and submarine war vessels, and land fortifications as well?

A single "partial success," a single "commercial counterfeit" airship could have discovered Admiral Cervera's "spook" fleet hidden in Santiago Harbor, and thereby saved expenditure of a million dollars daily in fruitless search, alarm, and "commercial" delay.

Weeks before the opening of our recent war with Spain, I offered to our government vessels modestly competent for such service. Within the last month of 1901 I have asked that a commission of the War Department be appointed to investigate the accumu-

lated possibilities of aerial navigation which I can present under pledge of secrecy. The paper accompanying this request detailed what these revelations cover.

My earlier offer was declined because the War Department had "no funds for purchase or construction of dirigible airships," and, when later called upon, I built only captive balloons for the Signal Service. If the later offer is declined or ignored, then commercial enterprise is ready to undertake it. What will happen when aerial navigation is open to the world?



BUFFALOS AT THE BERLIN ZOOLOGICAL GARDEN.

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When the submarine torpedo, driven by electricity and guided by "wireless telegraphy," threatens the vulnerable bottoms of ironclads, and the aerial torpedo driven by light and powerful explosive motors and guided by its crew, or from earth by wireless control from distant stations, threatens alike the submerged and floating warships and the armies and fortifications on land, all equally defenseless, what shall happen?

Peace! The world will not face annihilation. Armies and navies, and those who thrive upon them, may desire to prolong the struggle for such precedence as destruction gives; but the great human public, whose gifts in blood and money support warfare, will hope for peace in time.

Is it for humanity's sake that the International War Congress interdicted the use of dirigible airships and the highest type of explosives; or was it to prolong the existence of warfare and make it a safer "game"? Certainly no such interdiction was needed if aerial warships and extreme types of high explosives were harmless.

So much for gas airships, necessarily identified with my own personal experience and knowledge. There is much to be said of flying machines, aeroplanes and soaring machines, all of which I have as persistently

able in freedom, and in consideration of the lavish gifts he deigns to be lenient and forgiving.

The majority of the visitors are unaware of the fact that this gigantic, strong and courageous animal belongs to a race which hardly fifty years ago traversed the wide prairies of the United States by the millions, in herds of a thousand head and more, while to-day he is preserved from extinction only with much difficulty and at a great expense. The American bison (*Bison americanus*) is a relative of the aurochs (*Bos primigenius*), the wild ancestor of our European domestic ox) but especially of the bison (*Bison europaeus*), which is preserved in the park of the Prince of Pless in Upper Silesia and still occurs wild in the Lithuanian forests, as well as in the Caucasus. He was the chief hunting game of the formerly likewise numerous redskins and furnished them with all that was necessary for their existence, food and clothing. Unfortunately, the American bison was relentlessly pursued, partly by passionate hunters, partly from motives of blind greed. The white hunters knew no close season for cow or calf, their only desire being to take as many of the very valuable black manes and skins and horns as possible. Thus the number of buffaloes decreased most appallingly. The ever-increasing civilization also contributed its share to crowding them out, and where once buffalo herds roamed through the endless plains from north to south, from east to west, there is now no sign of the bison, nor of the Sioux or the Mohican. Today, iron rails on which the "steam-horse" speeds along are engirdling the prairie, the wild Indian chief with his tribe rests idly at the reservation, and the huge bison steer with the remnants of his family grazes in the vast parks, often twenty square miles large. How long before the redskin and the bison,

and with them all leather-stocking tales, will fall a prey to the pitilessly advancing civilization? How long before the "last Mohican" will appear with his impresario on the museum stage, and the "last bison" will lead a constrained existence in some zoological garden, faithfully protected and cared for by his friendly attendant?

For our engraving and the accompanying description we are indebted to *Illustrirte Zeitung*.

COMPOSITE FERTILIZERS.

THE fertilizers called "complete" for a given cultivation have no real advantage except that of being ready for immediate use, but on the other hand they are attended with great inconveniences.

Their regular application is often difficult owing to their pasty consistency. All of them have a base of superphosphate, with which mineral salts are mixed, rarely organic matter. Now, superphosphates have two properties. They are quite *hygroscopic*, that is to say, they absorb the moisture of the atmosphere readily and become pasty, and they are very acid, in consequence of the presence of free sulphuric acid, which they contain in excess, as well as a little free phosphoric acid.

The mineral salts incorporated with them are exceedingly hygroscopic; they are *deliquescent*, melting into water in moist weather, and tending to reduce these mixtures to a fluid state.

Superphosphate, even very dry, in which 20, 30, or 40 per cent of nitrate, or 20 or 25 per cent of chloride of potassium is incorporated, soon forms a pasty mass if the weather is at all rainy, as it is likely to be in the spring, the very time when these fertilizing compounds are forwarded and employed.

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which are set at liberty, by subsequent reactions produced in the mass, attack the sacks rapidly and render them useless. These are literally burned and often burst during transportation, allowing a part of their contents to escape, and becoming very troublesome in handling.

In addition to these disadvantages, there are others more serious, to which the cultivator perhaps attaches less importance, because he does not suspect them.

These mixtures contain both sodium nitrate and superphosphate; the latter, very acid as it is, reacts on the nitrate and sets at liberty nitric acid, whose vapors are disengaged. The loss of nitrogen is considerable, but it is greater if there are present ammoniacal salts or organic matters. Nitric acid is the most costly constituent, and the least loss should be prevented.

Also, ammonium sulphate is associated at times with phosphoric slag. This is a serious fault, leading to the disengagement and loss of a considerable quantity of ammoniacal nitrogen, which is also quite costly. The latter mixture ought never to be made.

As to the first, it may answer on the express condition that its employment is immediate, but it is not to be advised for the following reason. The most favorable time for spreading the nitrate is not the same as that for the superphosphate. The latter ought always to be prepared before plowing for the sowing, while the nitrate ought to be applied *en couverture* (mulching) when the vegetation has started; otherwise it is in danger of being carried into the subsoil by the rain.

In addition to these defects and the resulting loss, the formulas which serve for the preparation are not the same with different houses, and the customers em-

ploy them indiscriminately on lands of varied character. It thus happens that the cultivator will, for example, buy nitrogen, of which he has no need if his soil is sufficiently rich in this element. In a soil analyzing more than two parts of nitrogen in a thousand, and nitrifying well, the efficacy of the "complete" fertilizers for roots, for example, will not be superior to that resulting from the employment with the same percentages of the phosphoric acid and potash contained. Thus nitrogen, purchased at considerable cost, will be nitrified if it is in the organic or ammoniacal state, and in any case will be lost by infiltration in the subsoil.

Finally, the testing of the material is very difficult. It is comparatively easy to distinguish certain fertilizers, when they are pure and in separate masses, by the odor, consistency, or even the color, but this becomes almost impossible when they are mingled. Their proper odor is masked by that of the superphosphate, and even their color. Burnt leather may thus be substituted fraudulently for dried blood, of which the nitrogen is much more expensive. In a mixture containing organic matter, mineral superphosphates may be substituted for bone superphosphate.

If the cultivator wishes to employ such compounds, he should prepare them himself from materials well determined and on rational formulas adapted to the kind of cultivation and the nature of the soil. He will thus be benefited, not merely in a diminution of the cost, but in a better yield. He should reflect well before mingling substances which may react on each other to his injury, or those whose application should be made at different times.—Translated from *Le Phosphate*.

THE PARIS ALCOHOL MOTOR EXHIBITION.

The exposition of motors and apparatus in which denatured alcohol is employed took place in the Grand Palais from the 16th to the 24th of November last.

This exposition comprised three great classes, viz., (1) apparatus including stationary motors, motors for navigation, portable motors for operating pumps, etc.,

cellent results are due to the rational heating of the carburetor from the water circulation. Moreover, since the alcohol sprays through a nozzle placed in the center of the float and, striking an atomizing cone, is projected into a current of air that enters at right angles with the direction of the alcohol, an intimate and homogeneous mixture is formed, which then enters the motor.

(C) Single cylinder motors of more than 10 H. P., exhibited by Messrs. Brouhot & Co., of Vierzon, and

boat entered. The trials of it on the Seine, from the Pont de la Concorde to the Point-du-Jour, earned a gold medal for it.

Portable Motors.—Messrs. Japy Brothers' motor pump (Fig. 1), which obtained a gold medal, has a power in water lifted, that is to say, all effective performances included, of 1.39 horse power, with a consumption per horse in water lifted of 26.24 ounces of carbureted alcohol. In Fig. 3 we represent the Duplex portable motor, and in Fig. 4 we give a diagram of the

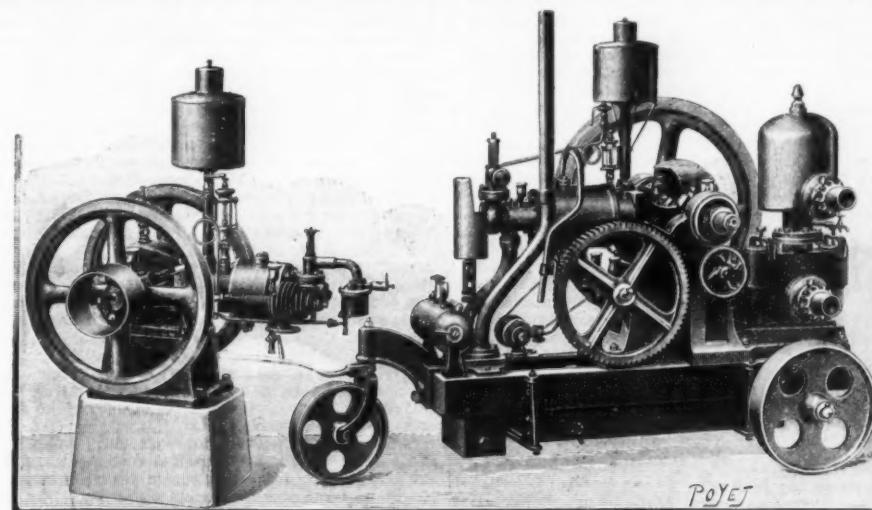


FIG. 1.—THE JAPY STATIONARY AND PORTABLE PUMP ALCOHOL MOTORS.

having the following characteristics: Power, 15.87 horse; diameter of the cylinder, 9.448 inches; stroke of the piston, 15.74 inches; speed, 180 revolutions a minute. The consumption was 13.47 ounces of carbureted and 12.13 of pure alcohol per horse power hour.

As a result of the competition, manufacturers are now putting at the disposal of French agriculturists

arrangement employed in the Charon 25 horse power motor for forming the carbureted mixture.

Automobiles.—The practical tests that served to class the automobiles comprised a trip upon the roads from Paris to Achères through Saint Germain, and return through Marly-le-Roi, comprising in all about 62 miles. Moreover, a 9-mile trial of speed and consumption was made upon the level track of Achères Park.

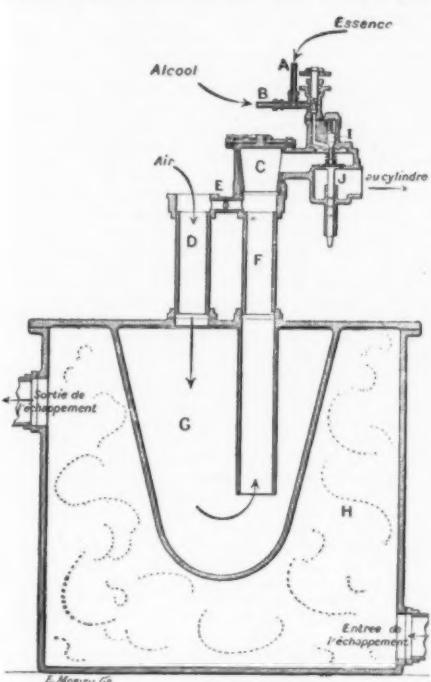


FIG. 4.—ALCOHOL CARBURETER OF CHARON MOTOR.

A, Inlet of gasoline for starting; B, Alcohol inlet; C, Hot air; D, Fresh air inlet; E, Valve for regulating the temperature; F, Entrance pipe of hot air; G, Heating chamber for air; H, Exhaust chamber; I, Valve regulating admission of alcohol; J, Inlet and vaporizing valve.

automobile motors, motors for boats, and carburetors; (2) lighting apparatus in which either pure or carbureted alcohol is used; and (3) heating apparatus, such as chafing dishes, soldering lamps, etc.

On the present occasion we shall occupy ourselves with the first class only. Practical tests of the stationary motors took place under the direction of M. Ringelmann, and of the automobiles under the direction of M. Henri de la Valette. We shall mention only the names of the competitors who obtained the highest awards in each category.

Stationary Motors.—These were divided according to their power into three sections, and a gold medal was awarded to each of them:

(A) Motor of less than 2 H. P., exhibited by Messrs. Fritscher and Houdry, the characteristics of which are as follows: Power, 1 1/4 horse; diameter of the cylinder, 3.346 inches; piston stroke, 6.299 inches; speed, 130 revolutions per minute. The ratio of the stroke to the diameter is 1:88. This being favorable to the expansion of the steam at the moment of explosion, the consumption proved satisfactory, in view of the fact that it was a question of very small motors. Such consumption was 22.75 ounces avoirdupois of carbureted and 22.68 ounces of pure alcohol per horse power hour. The carburetor is so arranged that the alcohol is heated by conductivity; the air by traversing hood around the exhaust; and the vaporizer itself by the exhaust gases.

(B) Single cylinder motors from 2 to 10 horse power, exhibited by Messrs. Japy Brothers, of Beaucourt (Fig. 1). In the 3.69 H. P. motor of this house the diameter of the cylinder is 5.7 inches, the stroke of the piston 6.299 inches, and the speed 310 revolutions per minute. The consumption is 14.07 ounces of carbureted and 13.96 of pure alcohol per horse power hour. Such ex-

and workers in the small industries carbureted alcohol motors, the consumption of which is no greater than that of similar gasoline motors, but which have the advantages of elasticity and cleanliness.

Motors for Navigation.—Messrs. Dalifol & Co.'s launch, 21 feet in length and provided with an Abeille 8 horse power carbureted alcohol motor, was the only

This section comprised quite a large number of classes, among which gold medals were awarded. In the voitures and light carriages class, one was awarded to the vehicle of the Société des Etablissements Georges Richard provided with a 5 horse power motor, weighing a 1,570 pounds in running order and having a consumption of 6.77 cubic inches of carbureted alcohol

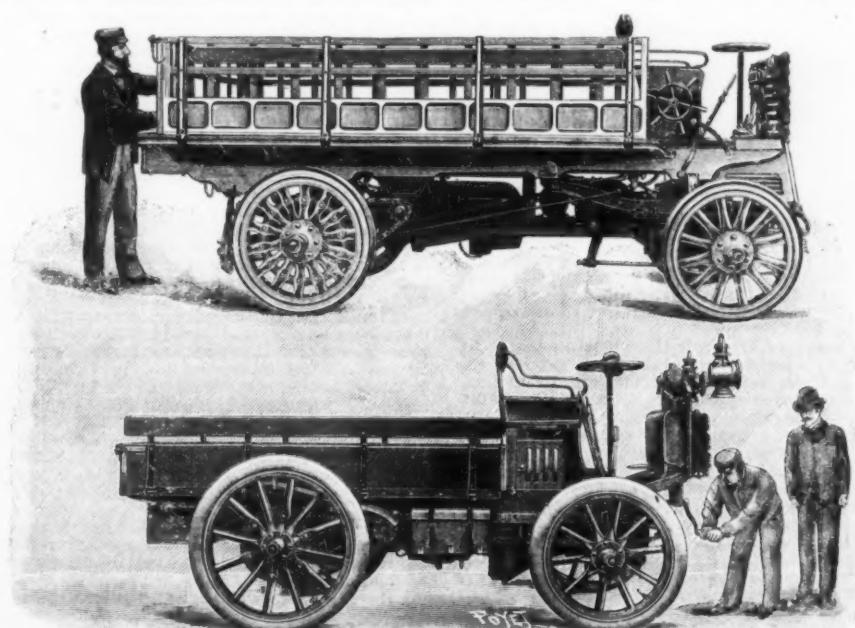


FIG. 2.—TEN HORSE POWER ALCOHOL TRUCK OF THE SOCIÉTÉ NANCÉENNE D'AUTOMOBILES.

per 2,204.6 pounds avoirdupois—an excellent result such as has never before been obtained with a light carriage.

In the section of carriages of over 1,432 pounds, a gold medal was awarded to the Société des Automobiles Delahaye. The two-cylinder motor of 7.39 horse power consumed 5.79 cubic inches of carbureted alcohol per 2,204.6 pounds avoirdupois. The vehicle weighed, loaded, 2,980 pounds.

Silver medals of large size were obtained by the Bardon and Vilain Société d'Automobiles et de Traktion, whose vehicles, operating with pure alcohol, consumed respectively 5.85 and 5.98 cubic inches.

Finally, in the section of industrial vehicles, the very remarkable result obtained by the large truck of the Société Nancéenne d'Automobiles constructed and steered by M. Brillé, gained a gold medal for both. This vehicle (Fig. 2), the efficiency of which is most remarkable, since it is 55 per cent (a figure never before reached), consumed, with a mean speed of 6 miles an hour, 5.85 cubic inches of carbureted alcohol per total kilometric ton (2,204.6 pounds), and 10.25 cubic inches per effective ton. This double result, which is of the most interesting character, is due to the 4-piston and 2-cylinder motor of 10 horse power, the dimensions and arrangements of which are very well adapted to the use of alcohol.

Isolated Carbureters.—Large silver medals were awarded to M. Martha and Mme. Longuemare for their carbureters especially arranged for the use of alcohol, and particularly of pure alcohol. It is well, too, to mention here the name of M. Lépêtré, who furnishes alcohol carbureted by means of benzole, and which was adopted by all the competitors in the classes of motive power.—For the above particulars and the illustrations, we are indebted to La Nature.

(Continued from SUPPLEMENT NO. 1363, page 21843.)

RECENT SCIENCE.*

III.

EXPERIMENTS tending to prove that adaptive characters in animals may be a direct result of their physical environment are evidently less numerous than they are for plants. Not only are such experiments more difficult, but they require also accommodations which the zoologist seldom has at his disposal. Our marine and lacustrine biological stations are few, and inland zoological stations are still smaller in numbers. Still, there are already a few researches which throw some light on the subject.

In lower animals variations are easily obtained by altering their surroundings. Thus Künster has found that with the protozoa a slight change in the conditions of their life, such as the keeping of the basins of the zoological garden all the year round under glass, results in considerable variation which renders certain species unrecognizable.* With higher organisms variation must necessarily be slower, but it is none the less evident. H. M. Vernon, who has experimented upon something like ten thousand larvae or *plutei* of echinoderms—chiefly sea-urchins—has found that the sizes of the larvae and the proportions of their different parts may be altered by mere changes of temperature. If the temperature of the water in which the fecundation of the eggs takes place be lowered to 46 deg. F., be it only for a minute, or raised beyond a certain limit, the obtained larvae are by about 5 per cent shorter than the average ones. If a small quantity of fresh water, or an extremely small quantity of uric acid be added to the salt water in which the larvae are bred, they will increase in size by from 10 to 15 per cent; and in all cases the proportions of the appendages to the body will be altered. Individuals which, if they were found isolated, would have been described as separate sub-races, are produced by mere changes of temperature, salinity, and proportion of nourishing substances in water.¹¹

The researches of Dr. A. Viré into the cave-dwelling animals of France, and especially the experiments he has made, under Milne-Edwards, in a laboratory specially arranged for this purpose in the obscurity of the Paris catacombs, are still more conclusive. It is known that the animals which live in caves and subterranean streamlets offer certain peculiarities. In most cases they are blind; their eyes have been atrophied, while the organs of touch and smell (Leydig's *Riechzapfen*) have taken a considerable development. The animal takes altogether a form so different from its nearest relatives living in broad daylight that the cave-dwellers are usually described by zoologists as separate species. As to the current explanation of the cave forms, it is well known. Out of countless accidental individual variations which occur in each species (slightly less developed eyes, slightly increased organs of the other senses), natural selection has picked out, in a long succession of generations, those individuals which accidentally exhibited variations favorable for cave-life. They survived and left progeny, while those which did not exhibit the useful variations died out. An explanation, by the way, which it is easy to suggest, but very difficult to submit to the test of experiment. Volumes have consequently been written to prove that such a "retrogressive variation" of certain organs offers no difficulty for the theory of natural selection.

The researches of Viré lead the whole discussion in a different channel—that of experiment. A few years ago Viré and Raymond discovered in the Cévennes caves two crustaceans which were described by Dollfus as new species (*Sphaeromides raymondi* and *Stenasellus viréi*).¹² Both crustaceans had no eyes, but the organs of touch (fine, movable hairs) and the organs of smell (the *Riechzapfen*) had taken a considerable development. The latter were especially large in comparison with those of the common *Asellus* which lives in the open-air little streams about Paris. It was found also that while the common *Asellus* of the

streams has a well-developed eye, colored black, the same *Asellus* has it much paler when it lives underground, and only a red spot is retained in the catacombs; finally, there is no trace of an eye in the Cévennes *Stenasellus*. This was the result of observation. Then, since 1897, Viré began direct experiments on these animals, which he continued in the laboratory opened in the catacombs. These experiments are only at their beginning, but still they have already given some important results. Placed in the open light the *Niphargus viréi*, which is colored in rose, becomes covered in a few weeks with pigment spots of a beautiful brown color, thus rapidly returning to its ancestral form. On the other side, the gray-green pigment of the common *Gammarus putaneus* begins to disappear after a ten months' sojourn in the tanks of the laboratory, and with most specimens it disappears entirely after a twenty months' stay in obscurity. As to the growth of the organs of touch and smell, they were developed in a common *Gammarus fluviatilis* kept for fifteen months in the catacomb laboratory (in forty-three specimens out of a lot of forty-six) so as to attain nearly half the size they have in the cave *Niphargus*. The evolution of the organs of smell began after a three months' stay in the underground laboratory. It is worthy of note that during the fifteen months that the experiment lasted the eye had not yet undergone any noticeable modification. Altogether the pigment of the eye seems to be much more persistent than the pigment to which the general coloration is due. We have thus, in Viré's work, the first steps made toward a real study of the origin of the first forms of animals; and at the very first steps in this direction nature was already caught in its work of making new species.

A considerable amount of research is being made at the same time in order to find out the physiological causes of color and coloration in the animal kingdom. Everyone remembers, of course, the charming chapter "Color and Environment" in Wallace's "Darwinism," written from the point of view of natural selection.

"In the Arctic regions (he wrote) there are a number of animals which are wholly white all the year round, or which only turn white in winter. . . . The obvious explanation of this style of coloration is that it is protective, serving to conceal the herbivorous species from their enemies, and enabling carnivorous animals to approach their prey unperceived. [And further on:] Whenever we find Arctic animals which, from whatever cause, do not require protection by the white color, then neither the cold nor the snow-glare has any effect upon their coloration. The sable retains its rich brown throughout the Siberian winter. . . . Then we have that thoroughly Arctic animal, the musk-sheep, which is brown and conspicuous; but this animal is gregarious, and its safety depends on its association in small herds."

But what about the Polar fox, it may be asked, one of the most gregarious animals in Steller's times?—the Arctic and sub-Arctic birds which surely need no protection when they come together in scores of thousands to rear their progeny in the Arctic and sub-Arctic lands?—the white Arctic owls?—or the Yakute horses, which also breed in small groups like the musk-sheep, never undergo artificial selection, and yet display that well-known marked tendency for a white coating? So much so that Middendorff, in our discussions in the early times of Darwinism, used to make of these horses a favorite argument to prove the necessity of a physiological explanation as against the natural selection explanation. It may also be added that those Russian zoologists who have had much to do with the animals of the steppes are inclined, too, to look for a physiological explanation of the dusky and sandy coloration of these animals.

The matter is, however, beset with great difficulties, which one realizes in full on reading the honest statement and analysis of our knowledge—or, rather, our ignorance—in these matters which is made by Miss Newbiggin in her book "Color in Nature" (London, 1898). We certainly are bound to recognize that the beautiful colors which we see on the wings of the butterflies and the moths are in some way connected with the physiological activity of the insect. Surely, as has been shown by Scudder and further confirmed by A. G. Mayer in 1897, the markings of the butterflies and moths are not accidental but structural. The markings are disposed symmetrically in the consecutive interspaces between the nervures; the ocelli are usually situated between the same branches of homologous veins; and so on. Even when the markings are changed in our experiments, the changes, as indicated by Fischer,¹³ follow certain rules; while other changes may be explained either by an arrest of development or an increased internal activity for maintaining the necessary temperature, as was suggested by Urech. We surely may continue to say that the markings of insects are "accidental," but we must take the word "accidental" in the sense Darwin used it—that is, due to causes still unknown—and in no other sense but this.

One fact relative to the colors and the markings of a number of butterflies and moths is, however, well established by this time; namely, that they depend to a great extent upon the conditions of temperature and light under which the caterpillars and the pupae of these lepidoptera have been reared. Such researches were begun some five-and-twenty years ago by Dorfmeister and Weismann, and have been continued since by Merrifield and Dixey in this country, Standfuss, Fisher, Urech and a number of other explorers. Mr. Merrifield began his experiments in 1887. It is known that many species of moths and butterflies appear under two different forms—formerly described as two different species—one of which is bred in spring and the other later on in the summer. This "seasonal dimorphism" is widely spread in nature, and occurs even in plants. Now Merrifield's experiments, in conformity with those of Weismann, Standfuss and others, have proved that one of the two seasonal forms may be bred from larvae of the other form by simply altering the temperature under which the larvae are reared. The two seasonal forms differ both in color and in their markings, but, to use Mr. Dixey's words: "The pattern or outline of the markings could be made to

vary independently of the general coloring, and he (Mr. Merrifield) obtained from the same brood individuals showing summer markings with summer coloring, summer markings with an approach toward spring coloring, spring markings with summer coloring, and spring markings with almost the spring coloring."¹⁴

As a rule, a cooler temperature gave darker colors, and cooling of the larvae without a subsequent forcing of them in a warm temperature gave the darkest moths. In the common butterfly, *Vanessa urtica*, a moderately low temperature generally deepened the coloring to some extent, lowered the tone of the yellow patches, and spread the dark portions. It appeared, moreover, that the size and, though less markedly, the shape of the wings were affected by the temperature of breeding; or, the wings being somewhat reduced in size, the scales become scanty and deficient in pigment, so as to show the membrane of the wing.¹⁵ It is also interesting to note that while some cooled specimens of *Vanessa urtica* bore resemblance to a northern variety, some of the heated specimens were like a southern form, and that (as was indicated by C. W. Barker) the rain-period butterflies of Natal differ from those of the dry period precisely in all those directions in which variation was obtained by cooling. Again we have in these experiments a peep, so to say, into nature's ways of originating new species.

Finally we have the well-known experiments of E. B. Poulton, who changed the colors of several common species of British caterpillars from green to various hues of brown and gray by rearing them amid darkened surroundings (black and brown twigs were mixed with their food, or they were placed in dark-painted boxes, and so on), and the experiments of J. T. Cunningham on fishes. Poulton's experiments are so well known to the general reader from his most interesting popular book, "Color in Animals," as also from Wallace's "Darwinism," that a mere reference to these now classical researches is sufficient.¹⁶ As to the experiments of J. T. Cunningham, although they are less known, they are also very conclusive. It is known that in most fishes the upper surface is more or less colored, while the lower surface remains uncolored, and has a silvery aspect; and that this double coloration is generally supposed to have originated as a means of protection for the fishes. It evidently permits a fish not to be detected by its enemies. However, Cunningham made experiments in order to see whether the absence of coloration on the ventral surface may not be due to the absence of light falling upon it. He consequently kept a number of young flounders in two separate basins, one of which was provided with mirrors so as to illuminate the lower surface of the fishes as well, while the other was of the ordinary sort. The result was that after a time a certain amount of coloration appeared on the ventral sides of the flounders of the first basin, first in the middle portion of the body, and then spreading both ways toward head and tail. It is true that small spots of pigment appeared on the ventral surfaces of a few fishes of the second basin as well, as they often do in nature; but the percentage of spotted individuals was small and the spots did not increase.¹⁷

It must be confessed that all these researches are only first steps toward the foundation of a science of which the need is badly felt—the physiological experimental morphology of animals. These first steps are in the right direction; but they are very slow, and probably will remain slow so long as the matter is not taken in hand by physiologists. Consequently, without even attempting to touch upon the wide subject of variation in free nature, or of paleontological evidence, I will permit myself to mention here one set only of observations taken from this vast domain, because they throw some additional light upon the facts mentioned in the foregoing pages. I mean the well-known wonderful collection of land mollusks which was brought together by J. T. Gulick, and which illustrates the incredible amount of variation that takes place in the family of *Achatinella* on the small territory of the Oahu Island of the Sandwich group. Having lately had the privilege of examining this collection at Boston under the guidance of Prof. Hyatt, who gave me full explanations about the work he is doing now upon this collection, I will take the liberty of adding a few words to what has been said about it by Wallace and Romanes. The Oahu Island has, as is known, a range of mountains nearly forty miles long along its eastern coast. Several valleys are excavated on the inner slope of this range, and each valley has its own representatives of the *Achatinella* land mollusks, which could be described in full conscience as separate species, more than one hundred in number, with several hundred varieties. A broad valley separates this range from another shorter and lower range running along the opposite coast.

The doubts which the author of "Darwinism" has

¹¹ P. Kropotkin, in the Nineteenth Century. Reprinted by permission of the Leonard Scott Publication Company, New York.

¹² Actes de la Société Linnaéenne de Bordeaux, vol. III, p. 1; summed up in Annuaire Biologique for 1898, IV, 450.

¹³ H. M. Vernon, "The Causes of Variation," in Science Progress, vol. xl, 1897, p. 229.

¹⁴ Comptes Rendus, vol. cxxv., 1897, pp. 130, 131; Armand Viré, La Faune souterraine de France, Paris, 1900. The book contains all necessary illustrations and a full bibliography.

¹⁵ Entomologische Nachrichten, 1898, xxiv., p. 37; summed up in several scientific reviews.

¹⁶ F. A. Dixey expressed, in connection with Merrifield's experiments, the idea that certain of the modifications produced in *Vanessa atalanta* by heat and cold show a return toward the ancestral type of *V. callirhoe* and to a still older form of *Vanessa*. Fischer, on the basis of his extensive experiments, expressed also the idea that the variations provoked in butterflies by different temperatures are stages of development (Hemmungs-Erschöpfung), in consequence of which older structures become fixed; and he developed the same idea in a book, *Neue Beobachtungen und Untersuchungen und Betrachtungen über das Wesen und die Ursachen der Aberration in der Faltergruppe Vanessa*, Berlin, 1896. The idea is, however, contradicted by Urech, and needs confirmation.

¹⁷ The experiments are most suggestive, and raise a number of secondary questions, for which the original memoir must be consulted in Transactions of the Entomological Society of London, 1892, p. 293 (good Summary by G. H. Carpenter in Natural Science, April, 1893, II, 287), as also the memoir of Miss Lilian Gould and two of W. Bateson in the same volume. The memoir of E. B. Poulton contains also observations subsequent to the publication of his book.

¹⁸ Journal of the Marine Biological Association, 1893, III, p. 111. Summed up in many reviews; also in Miss Newbiggin's book. Considerations of space compel me to leave for another occasion the "willful" changes of color in certain animals which may be better dealt with in connection with mimicry.

expressed concerning the complete identity of climatic conditions in all the valleys are probably justified. There is, I was told, a slight difference between the maritime and the land slope of the first range, and there is, so far as information goes, a difference in the rainfall at one end of this range and at its other end. But when one sees the strikingly minute and yet persistent differences between the species and varieties—each limited to its own valley or valleys—and grows acquainted with Prof. Hyatt's many years' work in order to follow the mollusks in their migrations from the maritime slope to the different valleys of the land slope, and next across the flat land toward the second ridge, and sees the growth of this or that minute distinction in the course of time and migration, one cannot but accept the explanation of Prof. Hyatt. Variation once having set in a certain direction has continued in that direction so long as conditions not unfavorable for it have prevailed; and isolation, geographical and physiological, has prevented cross-breeding. On the other side, on examining the collection of Gulick, one feels that one must overstrain the potentialities of that admirable theory of natural selection if one attempts to explain through it the maintenance and the growth of such insignificant yet persistent specific characters, as, for instance, the very slightly different markings appearing in this or that species, and gradually developed in the next ones.

We have thus a solid body of evidence growing from year to year, and showing us how variations in the structure and the forms of animals and especially of plants are arising in nature as a direct result of the mutual intercourse between organism and environment. To this Weismann and his "neo-Darwinist" followers will probably reply that all these facts are of little value, because acquired characters are not transmitted by heredity. We have seen that in plants they are. No botanist evidently believes that a scar in a plant or a mutilation can be transmitted, any more than a scar in the ear of a man or a clipped tail in a rat, which, as Celsus remarks, is made to breed immediately after the tail has been clipped. But the most prominent botanists are of opinion that if the equilibrium between nutrition (in its wide sense) and expenditure has been broken, and a new adjustment has been produced in the plant, this adaptation will be transmitted in most cases by heredity; and that so long as the new conditions last, the plant will not have to begin its adjustment afresh in each generation. The effect will be cumulative. We are consequently authorized to suspect—although proof or disproof of this has not yet been attempted—that something similar will be found in animals; that, for instance, the cave animals of Viré, born from his *Asellus* specimens in the underground laboratory, will not have the eyes so developed, and their olfactory organs so undeveloped, as they are in an *Asellus* taken from an open-air stream.

As to Weismann's theoretical views one remark only need be added here to what has been already said in a previous Review (April, 1894), namely, that most of the founders of our present knowledge about fertilization refuse to accept Weismann's theories, and that one of them, Boveri, has lately proved by continuing his series of remarkable discoveries that the whole question of heredity is still in a state in which generalizations like Weismann's are premature. They surely stimulate research. But no sooner are they born than they must be recast, new discoveries still rapidly following each other. But this subject is so interesting in itself that it will have to be dealt with separately on some future occasion.

THE THERAPEUTIC VALUE OF REST.

BY A HOSPITAL PHYSICIAN.

At the present day almost the first instruction given in any case of sickness or injury is "go to bed." First enforce complete rest for the entire body until the primary shock of the difficulty is over. Then determine just what organ or function is most at fault and let the remainder resume their ordinary work, subject of course to proper supervision while keeping the imperfect one under absolute control.

The creative processes of the body may be considered as growth and repair. Growth is usually considered to be a property of youth only. In adult life the bodily functions are not engaged in corporeal growth, but they are in mental growth. In old age there is usually no growth. To elaborate a little more—in youth, both body and mind are expanding in every way. The framework or skeleton is increasing in all its dimensions and all the organs are enlarging also. Leaving out of mind all extraneous influences, this process of growth continues until from the twentieth to the twenty-fifth year, as a rule, when the body framework and the visceral organs "reach their growth." From this time on we see practically no corporeal growth, but we do see the mental improvement or ripening while the body stands practically still until we reach old age—which is not differentiated by any number of years—when the bodily and mental powers begin to decline and there is no growth. Barring outside deleterious influences the process of growth is the natural law then until old age is reached.

These influences which are acting from earliest childhood require that the marks made by their onslaughts be eradicated unless we are to be permanently scarred. Fortunately "nature" has instituted the processes of repair to obliterate so far as possible these scars. Normally there would be no need for repair of the body while it was growing nor of the mind while it was developing, but all of us are exposed to these destructive influences from the very first, so that our bodies and minds require the processes of repair at the same time with those of growth. After the onset of old age, repair is the only process at work.

Beginning at birth, the beneficial effects of rest are seen in the fact that as a general rule, other things being equal, the baby who sleeps the most makes the most satisfactory progress. At this time the child should be allowed to sleep and should not be wakened up to be shown to admiring friends and relatives. The first symptom of trouble is usually restlessness instead of normal sleep. At this age the treatment of such restlessness should be hygienic and dietary and only rarely medicinal. The use of "soothing sirups" which

are really breeders of much mischief is to be condemned in the strongest possible terms. As far as is known to the writer they all contain opium in greater or less proportion. A case comes to mind of a typical opium habit in a baby less than a year old from the use of a soothing sirup "guaranteed free from any injurious ingredients." The details of the case are not pertinent here. Suffice it to say that the withdrawal of all opium and careful regulation of the diet so that the body received the proper elements for its growth restored the little one to his normal condition. Here as everywhere the treatment consisted in relieving the organs from improper work—in other words resting them.

We must take care that in relieving one set of organs we do not overtax others and consequently prevent what we are seeking to accomplish. For if we are so unfortunate as to weary all of our organs we are then indeed in a pitiable state. We see the natural impulse for rest when repair is necessary in the actions of animals. Whenever a dog or cat is sick or injured, it crawls away and remains absolutely quiet. Likewise after protracted suffering, when the cause is removed a human being normally seeks sleep, that the bodily functions may be as far as possible obliterated and that the processes of repair may be allowed to proceed unmolested. The reason we become exhausted by protracted effort and loss of sleep is because repair does not have opportunity to keep pace with the demand on our organs for energy.

It is unnecessary to recite the various surgical conditions requiring rest for their cure. We all have seen the pain of a fracture relieved by the proper setting of the broken fragments and their immobilization in a suitable apparatus.

In this connection we must not err in considering that absolute disuse of an entire limb must be enjoined on account of a fracture. Repair will take place the more quickly the better the circulation is. Of course in fracture of the femur or thigh bone rest in bed is necessary until repair is completed, but in fracture of the tibia or fibula it is frequently well, if one be skilled in the use of plaster of paris, to encourage the patient to walk about using the fractured limb somewhat. The broken bone must be absolutely rested, but the remainder of the leg may be used. This is more generally seen now in the treatment of sprains by supporting the joint with a proper dressing of rubber adhesive plaster and encouraging the moderate use of the part. In very severe cases where the ligaments are extensively torn this may not suffice at first, but as soon as possible, normal use of the sound parts should be encouraged while the injured parts are kept absolutely at rest.

In tubercular disease of the bones and joints we employ prolonged rest. By no means all cases are put to bed, but by means of proper apparatus the joint or bone involved is put entirely out of work.

Thanks to Taylor and Sayre in this country during the past generation, and to many men now living, we are able to rest one or more joints without enjoining absolute inactivity.

In another distressing and unfortunately not uncommon condition, namely, varicose ulcers, we employ rest most successfully. In some cases that have been long neglected we may need to put the patient to bed, but if proper measures have been employed from the first, few cases ever become very bad. Much stress is laid by the laity on this or that salve or powder. In some cases these do the work, but if the leg be snugly bandaged from the toes to the knee, thereby relieving the congestion which the dilated veins allow and at the same time preventing the margins of the ulcer from being stretched and contorted by the movements of the different muscles of the leg, the same result is usually obtained in a much shorter time and with very little help from the dressing itself. As an additional agent we use strips of adhesive plaster, preferably the diachylon plaster, as the heat necessary to make it adhere firmly and readily in a large measure sterilizes it. These strips are cut from one-quarter to half an inch in width and long enough to extend at least two inches beyond the margins of the ulcer on either side. While the strip is being heated an assistant draws up the edges of the wound, and the strip is pressed against the leg, holding the skin in its new position and taking all the strain of the stretching upon itself and so resting the ulcer and allowing repair to proceed. It is usually necessary to use more than one strip. They should be applied preferably at right angles to one another, leaving vent holes for the ready escape of the wound secretions into the dressings.

One more illustration and we are done with the surgical aspect. The use of stitches in a wound is for the two-fold purpose of bringing the edges together and also of holding them perfectly still. No matter how closely the cut edges are brought, unless they are held together firmly and continuously the union is not prompt and good. As an auxiliary to our stitches we again employ adhesive plaster frequently. In this case, however, we may better use the ordinary rubber adhesive plaster, as it adheres better. This is, of course, always put on after a few layers of dressing are applied over the line of suture. The bulk of the dressing may be applied over the plasters.

The application of the principle of rest is also necessary in medicine, and it is here that we play one organ against another when one of them is more or less disturbed in its functions. No attempt will be made to study the different phases of this side of the subject in detail further than was done on the surgical side. We will simply mention some of the most striking and important points.

In many cases of acute pleurisy, where the pain caused by the respiration and the cough is intense, instant relief is obtained from "strapping" the affected side with adhesive plaster. There are two methods of accomplishing this; one by using a wide strip extending entirely around the chest; the other of using many narrow strips and applying them on the line of the course of the ribs. The strips need not always go completely around the chest, but should extend well onto the unaffected side both in front and behind. One end of the strip should be pressed firmly against the unaffected side, while after a full expiration the patient expels all the air possible from the chest and the rest of the strip is quickly drawn closely around the body and held firmly until it adheres securely. One

strip four or six inches wide may be applied, or from two to four strips two inches wide may be used.

In affections of the heart we use rest in almost every condition or else rest alternating with regulated work. The idea must not be held that because a person has "heart disease" he or she must remain quiet all the remainder of life. There is no other organ that so well adapts itself to the carrying on of its work after it has been injured or worn by disease as the heart when it is given a fair chance. Digitalis is of use chiefly for its action of prolonging the period of rest in the cardiac cycle, but putting the patient to bed during the attacks of weakness will frequently accomplish the same result without incurring the risks of using this drug or any other. Of course it must not be understood that simply rest in bed will relieve all cases of cardiac trouble, but many sufferers can be relieved by simply putting them to bed, unloading the bowels and giving a simple diet for a few days.

This is even more true in kidney disease. Here, paradoxical as it may seem, we rest our organ by giving it more work to do. It is not the amount of fluid that passes through the kidney and comes away as urine that causes the strain on the organ, but the amount of toxic products that have to be cast off. We first administer a vigorous purgative, desiring to get several large watery stools and so remove as much toxic material from the body by way of the bowels as possible. By having the patient in bed we are able to open the pores of the skin without danger from cold. Now having removed as much noxious matter as we can, we proceed to make the patient drink large quantities of water to dilute as far as possible the ingredients that must be cast off by the kidneys themselves. The process of the passage of plain water through the kidneys is accomplished with practically no strain on the organs themselves, and the less concentrated the substances to be cast off are, the easier it is for the organs to care for them. So we have our paradox of the kidneys excreting a large amount of urine with less wear and tear on themselves than when they are producing less.

Instances might be multiplied by naming and discussing each organ in turn, but that is not our plan. We will say only a few words on the nervous system and then on diet.

We will take the nervous system surgically and mechanically, at the same time urging the more thorough application of rest in the treatment of all or nearly all nervous affections. After all accidents involving severe shock, the patient should remain in bed until the effects have passed off, and just because he or she is able to nerve himself or herself up to carry on regular work is no proof that they should be allowed to do it. Repair is best effected when all unnecessary strain is removed. On the other hand, in many nervous breakdowns from over-worry, the rest in bed may need to be supplemented by vigorous physical work. Very many cases are simply the result of intestinal indigestion, whereby improper products are absorbed and then act as direct poisons to the cells of the nerve centers. In these cases absolute rest in bed with a strict milk diet until the exciting cause has been removed is the surest way of accomplishing a cure. By a little perseverance it will be found on the part of the patient and physician that nearly everyone can not only live on milk, but can get well on it. When the digestive powers are weak it is manifestly better to give them their work to do in a way that they can do it. Then as they can do more work, give them more of it to do. Care must be taken to avoid any constipation at any time. There is no danger in using free catharsis at the beginning, and then as the conditions improve, less and less is required. In almost every disease it is best to use only the simplest form of food, and if the patient does not have to be talked to by friends who think it is so hard on him that he must lie in bed and drink nothing but milk or water, he very quickly overcomes his natural dislike for "slops." The objections to soups, broths, etc., are two-fold. They contain little or no real food and they do increase the tendency to uric acid production. By adding a very little salt to the milk it may frequently be made more palatable. No mention should be made to the patient that it is time for more milk, but it should simply be taken to him at regular intervals of one or two hours. Some patients prefer two every two hours. The interval as a rule should not be longer than this, nor the quantity larger. In this way by beginning the day at seven o'clock in the morning and going on until nine or ten o'clock at night, the patient will take about four quarts in the twenty-four hours. Such a quantity of milk is the equivalent in food units of any ordinary amount of food consumed during the regular three meals a day. It must be remembered that although a patient is in bed he needs nearly the full amount of food units, for he must supply enough for the ordinary wear and tear of the body and also enough to overcome the disease from which he is suffering.—Druggists' Circular and Chemical Gazette.

LIFE IN A WAVE-CREST.

THE following appears in *Knowledge* from the pen of Mr. A. Earland, who writes for students of microscopy: "Probably everyone has noticed when at the sea-side the white lines which run along the sands, parallel with the retreating tide. A pocket lens shows that the white material consists of the minute shells of *Foraminifera*, of which some are of a lustrous white color, due to the comparative abundance of the *Miliolidae*—a family of common occurrence in shore gatherings, characterized by opaque shells of a milky white or "Porcellanous" texture, while others are more or less glassy and transparent. These "Hyaline" forms are much less noticeable to the naked eye. They are mixed in varying proportions with fragments of shell substance, *Ostracode* shells, cinders and the lighter débris of the shore, and their presence in these lines is due to the separating action of the water. . . . The rocking action of the wave on the extreme edge of the ebbing tide keeps these shells and fragments of light specific gravity in suspension until after the heavier sand grains have subsided, and so they are left behind in the ripple marks and depressions of the sand. Sometimes a local eddy of the tide, produced by the neighborhood of a projecting

rock, or of groynes and piers, causes the material to be gathered together in large quantities, which show as extensive white patches on the sand, and prove a real gold mine to the collector, who will then obtain more material in half an hour than he could gather in several days from the ripple marks."

THE EARLY INHABITANTS OF THE DANISH WEST INDIES.

WHEN the United States acquires the Danish West Indies, as at present seems very probable, it will come

newspapers, besides several other evidences of modern civilization, such as churches, banks, etc.

St. John, which lies east-northeast of St. Thomas, has an area of only 42 square miles. Its chief exports are cattle and bay-rum. The capital, Crux Bay, has only about one hundred inhabitants.

At the time when Columbus discovered America, these islands were inhabited by Carib Indians, who may be justly regarded as the Phoenicians of Eastern America. They spent most of their time on the water. They had no sailing ships or steamboats, it is true, but they felt perfectly at home in their large dugout

tire coast of the Caribbean Sea, taking care, however, always to keep as close to the shore as possible, in order to avoid being overtaken by those terrible hurricanes, the horror of which came home to us in September, 1900, in the storm on the coast of Texas.

The Caribs were a purely neolithic people, and were not savages, but, according to an eminent authority, were rather in the middle stages of barbarism. For food, in addition to the natural fruits they prepared maize and cassava, and also fermented drinks. They lived in rectangular huts with palm-leaf thatched roofs, grouped in villages. They made pottery, in which the ornamentation, bold and realistic, was produced by modeling. The climate was such that they needed but little clothing, and this they wove of cotton. For the same reason their houses were without walls,



INSCRIPTIONS.

into possession of one of the most interesting regions of the globe, viewed from the standpoint of the ethnologist.

The Danish West Indies are three in number, viz., Santa Cruz, St. Thomas and St. John.

Santa Cruz (or Saint Croix), the largest of the three, lies sixty-five miles east-southeast of Porto Rico;

canoes. Some of these were long and wide enough to hold fifty persons with their outfits. These Indians were wonderfully accurate observers of storms, and could give points even to our present distinguished Weather Bureau. The breaking of waves on the shore was a sufficient index, as a rule, to those born navigators, and no doubt their attention to the peculiar roar of



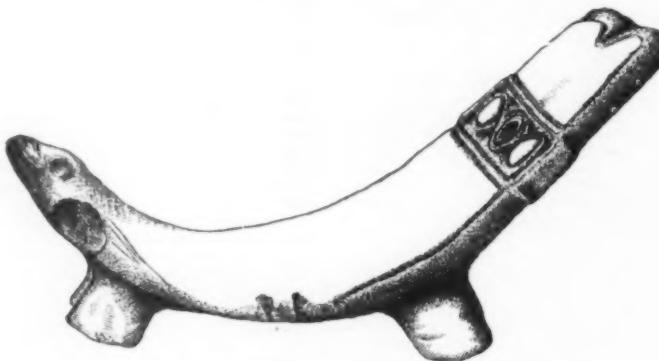
CELT OF JADEITE IN A HANDLE OF WOOD, TURK'S ISLAND. One-sixth.

but separate apartments were arranged inside the huts by means of matting. They slept in hammocks, and knew nothing of our comfortable beds with double-spring mattresses! The kitchen was out of doors, so that the angry voice of the chef upbraiding his subordinates was unheard by the master, who might be taking his mid-day siesta, rocked in his homespun hammock. They had wholesome marriage laws, similar in general to the clan system in vogue among the Indians of North America.

Mention has been made of cassava as one of their foods. This was a kind of tapioca, prepared from the juice of the shrub of that name, belonging to the



FLAT KITE-SHAPED MASK. One-half.



ANIMAL-SHAPED STONE STOOL. One-third.

it is about twenty miles long and five miles broad. Sugar, rum, cotton, coffee and indigo are the principal products. The capital and residence of the governor is at Christiansted. The island has been owned by Denmark, Great Britain, Spain and France. It was taken by the British in 1807, and restored to Denmark under the treaty of Paris.

St. Thomas, the second in importance, is thirty-eight miles east of Porto Rico. Its surface is rugged and elevated, and the greater part of the island is uncultivated. The capital, Charlotte Amalie, contains about 14,000 people, and has a daily and two semi-weekly

the breakers at the approach of a storm saved many a life. Their canoes, provided with keels, were beautifully made. The sides were raised with canes, and they were daubed over with bitumen. They closely resembled the canoes of the northwest Haida and Thlin-kit Indians. In them the natives would skirt the en-

Spurge family Euphorbiaceae. Made into a bread, this food served the natives an excellent purpose when out on their long voyages, as it was readily prepared and preserved.

They kindled the flame for their fires by rubbing two sticks together. They were very fond of sports and in-



A FRAGMENT OF POTTERY.



A HUMAN FIGURE CARVED FROM A SINGLE LOG OF WOOD.

dug freely in sham battles, which often became so rough that many were wounded or killed.

They occupied other islands than the three already named, and Porto Rico was a part of their realm. The large number of elegantly formed objects of sacred

use states that a sailor of Columbus reported having seen a man with a white tunic down to his feet, and another averred that he had seen a man curiously garbed on one of the islands and resembling a Catholic priest. It is said that on one of their islands the na-

some of them are over twenty inches long and sixteen inches wide. There are right-shouldered and left-shouldered collars, distinguishable by the position of a projection on the outside of the upper limb of the circumference. The panels of these collars were often

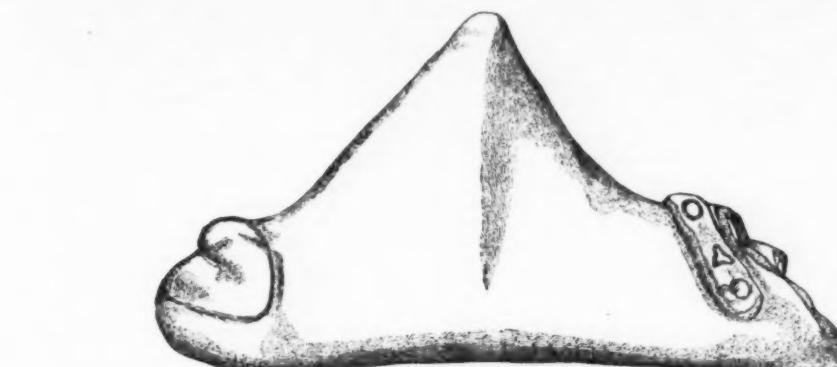


CARVING OF TWO INDIVIDUALS SEATED ON A CANOPIED CHAIR.

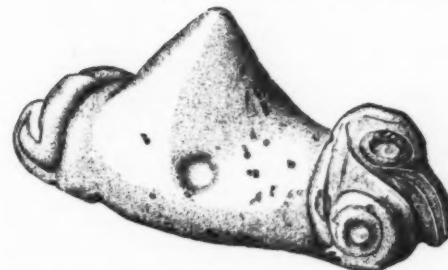
significance which have been collected there, seems to prove that this island was peculiarly devoted to the performance of their religious rites. In some of the smaller islands, particularly Guadeloupe, stone implements of extraordinary finish and symmetry have been found. Some specimens of their workmanship are shown in the accompanying cuts.

Chipped stone implements are rarely found on these islands, because of the lack of siliceous rocks. In many of them shells are the only material available for making any kind of implement.

It seems curious that such a rude people should have had an artistic temperament, but indeed they have



MAMMIFORM STONE, WITH HUMAN FACE. About One-half.



MAMMIFORM STONE, WITH THE HEAD OF A SEA-BIRD. One-fourth.



MAMMIFORM STONE, UPPER VIEW, GREATLY WARPED. One-fourth.



MAMMIFORM STONE, FRONT VIEW. One-third.



MAMMIFORM STONE, UPPER VIEW. One-fourth.

tives bound small images of their gods to their foreheads before going into battle. Large mammiform stones are quite common. Their appearance has been alluded to as recalling the legend of Typhoeus, who was said to have been killed by Jupiter with a flash

elaborately ornamented, as shown in the accompanying cuts. Being of stone, it seems incredible that these collars were actually used for harness for their cattle, and yet what other use they could have served has not even been conjectured.



LEFT PANEL, PANEL-ORNAMENT, PANEL-BORDER, AND BOSS OF A RIGHT-SHOULDER SLENDER COLLAR. About One-third.



LEFT PANEL OF A RIGHT-SHOULDERED SLENDER COLLAR, WITH ITS ORNAMENTS. One-third.

been described as "prodigies in design and workmanship."

Their arts are well illustrated in a collection now on exhibition at the National Museum in Washington. It contains pieces of pottery ornamented with animals' heads, that of the monkey predominating. Others have human faces, which are exceedingly grotesque, or

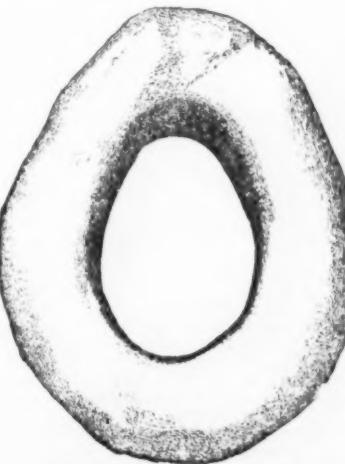
of lightning and burned beneath Mount Etna, which, however improbable, is at least suggestive of early communication between the Greeks and the primitive people of the West Indies. Carved stones representing human faces are found, bearing a strong resemblance



A LEFT-SHOULDERED SLENDER COLLAR. One-sixth.



RIGHT-SHOULDERED MASSIVE COLLAR. One-sixth.



UNFINISHED COLLAR. One-sixth.

faces of mythological animals. The celts or axes are of the highest order of workmanship, and are beautifully shaped out of fine grained material varying in color from black to nearly white, while many are of a jadite green. Evidences of their religion are shown by amulets and stone images. An authority of high re-

to the masks used in pantomimes. They were presumably used in games or ceremonies of some kind. But the most extraordinary objects are those which have been termed "Collars," although no one has yet succeeded in discovering the use which the natives made of them. They are shaped like horse-collars, and

ment to find out more about this long vanished race and their peculiar arts and habits of life.

The illustrations in this article are taken from Prof. O. T. Mason's able paper on the Latimei collection of antiquities from Porto Rico and the Guesde collection from Guadeloupe.

CHARLESTON AND ITS EXPOSITION.

THE "Exposition" business promises to become a "continuous performance" in these United States. The Pan-American is almost immediately succeeded by the South Carolina Interstate and West Indian Exposition, which is to be "inaugurated" at Charleston, with ceremonies, including an oration by Senator Depew.

Then will ensue the "Louisiana Purchase" at St. Louis, and doubtless some other community will be moved to follow that up with some advertisement of its own resources and advantages. The experienced "exposant" who finds his account in exhibiting his wares will be likely to find his account also in a standing exhibit, and sending it about as occasion serves.

The greatest of American exhibitors, Uncle Sam himself, has already adopted this plan. By agreement of all studious visitors, his exhibit at Buffalo was one of the very best worth seeing. It had a distinct national value in acquainting the people of the United States, by the most vivid form of object lesson, with what their government has done and is doing in all its executive departments.

This exhibit has been transported bodily to Charleston. It will be well seen there, although Congress declined to make provision for housing it. It will occupy the curved and colonnaded wings that connect the "Cotton Palace," the largest and central building of the "Court of Palaces," with the buildings that line the two sides of the central quadrangle.

In many other respects the projectors and managers of the fair at Charleston will find their labors simplified and lightened by the fair at Buffalo. In the department to which the Pan-American owed its name a seaport like Charleston has evident advantages over a lake port like Buffalo.

While the first object of the new Exposition is, like those of Atlanta and Nashville, to exhibit the resources and the industrial progress of the South, the second is hardly subordinate, of making Charleston the port, so far as possible, of the West Indian trade, which is so clearly destined to increase in importance.

Evidently, from the map, Charleston is the natural port of that trade. The harbor, which in colonial times and later made the city a rival of the cities of the Northern coast, has been so greatly improved by the labors of Gen. Gillmore and his successors of the United States Engineers that it is far better than it was in its most prosperous days.

The jetties have done their work so well that whereas there were but thirteen feet of water on the bar at flood tide when the improvement began, there are now thirty, and the channel is still deepening. The improvement has been recognized in the transfer of the naval station of the Carolina coast from Port Royal to a point on the Cooper River, seven miles above Charleston Bar.

The Pan-American part of the Buffalo fair was by no means its most successful element. Such as it was, it is expected to appear at Charleston, with additional exhibits from the West Indies, Mexico, and Central America.

The curious similarity between the topography of Charleston and that of New York must strike every visitor, and appears plainly from the map. Every natural feature of one has its counterpart in the other, the chief difference being the reduced scale of the Southern example.

"Charleston Neck" is, indeed, a peninsula and not an island, but Spuyten Duyvil is not a very important water course. The Ashley corresponds to the Hudson, although it is less than fifty miles in length, and in width rather less than half as great as our river, and the Cooper corresponds to the East River, though the Cooper is a true river and not an estuary.

Nay, even Coney Island has its analogue in the Isle of Palms, which is put to the same uses as a suburban pleasure resort, while Sullivan's Island corresponds accurately to Fort Hamilton. A main difference, and one in favor of the pleasantness of Charleston, is that the "Battery," also-called, at the foot of the peninsula, is still the fashionable quarter of residence. The sight of it, with its bordering park of live oaks, and the outlook from it down the bay inspires the thought how much more eligibly the wealthy people of Manhattan used to be housed before they were driven miles northward by the demands of commerce.

The site chosen for the Exposition corresponds to Spuyten Duyvil, though it is only two miles or so northward from the Battery. It borders the Ashley, so that deep-water ships can unload directly at Exposition Wharf.

The front door of the Exposition, however, is not on the water gate, but at the other end of the grounds, accessible by trolley or carriage, and, indeed, not beyond walking distance from down town.

Here is a site of about 160 acres, very sharply divided into two nearly equal spaces, and connected only at the corners by the narrow strip of land on which stands the Administration Building, alongside of which is the main, and, indeed, the only entrance giving access to each division. One is, or was, merely a sandy plain. The other contains "Lowndes's Grove," the home park of one of the most interesting colonial mansions in South Carolina, or, indeed, anywhere else.

It was the home of the Lowndeses before the Revolution, which the building antedates, but is now the property of Capt. Wagner, the president of the Exposition Company, whose public spirit has been a very important factor in all that has been done for the fair. The mansion and the grounds he has given the use of to the Exposition, and has thereby secured for it a quite unique attraction. The house, with considerable temporary additions, is to be occupied as the Woman's Building, and the grounds, which are covered with a magnificent grove of live oaks, remarkable even in this country of live oaks, stretch along the water front for some 2,000 feet to the artificial basin which contains the "Electric Island" that is to be one of the features of the fair.

All this part of the grounds is already a pretty park, and such buildings as it contains are irregularly disposed and designed, without reference to each other, the primary purpose being to preserve the sylvan landscape. Among the noteworthy buildings are the State

buildings of New York, Maryland, Illinois, and Pennsylvania, and in addition a special building of the city of Philadelphia.

New York has evidently taken less seriously than Philadelphia and Baltimore the opportunity to cultivate Southern trade which the Exposition will afford. The Merchants' Association has been conspicuous in what has been done, but the Legislature has appropriated only \$15,000 for the entire expenses of the State Commission, including the New York building, which has accordingly been much restricted in size. It is a pretty piece of design, a Spanish "casa" built around a patio.

Maryland shows a classic front which fits prettily into the landscape and is worth looking at on its own account. Illinois contributes a roomy and more or less "Colonial" mansion of two stories, with two pedimented ends, and a recessed center fronted by an Ionic colonnade for the whole length, and crowned with a four-hipped roof with a balustraded deck.

Pennsylvania has an equally extensive building, but this, with its belvederes and its verandas and its curved galleries, conveys a distinctly tropical suggestion. Philadelphia is represented by a classical design, which the desire of signaling it as Philadelphia has marred by adjoining to it a reproduction of the belfry of Independence Hall with a highly incongruous result.

But each of these communities is more extensively represented than New York, necessarily, since New York appropriated only \$15,000 against the \$25,000 of Illinois, and the \$35,000 each of Pennsylvania and Philadelphia. Twenty-four States and cities are represented in all by buildings and exhibits, or both.

The most striking of the buildings in this part of the grounds, however, is the Art Building, designed by Mr. Bradford L. Gilbert, the architect-in-chief of this Exposition, as he was of that at Atlanta. That he has done so much with so little must be a source of astonishment to the spectators of his work.

It is said that, with the cheapness of Southern pine, the structural basis of all the buildings, on its native heath, several times as much building can be done in Charleston as can be done in New York for the same money. One is quite prepared to believe it when he is told that the "Court of Palaces," the Charlestonian equivalent of the Court of Honor at Chicago, and of the Court of the Fountains at Buffalo, has cost less altogether than the Electric Tower at Buffalo alone.

It befell that when the Dewey Arch was ordered down and was about to be converted into junk, it struck the architect of the Charleston Exposition that decorations which had excited so much admiration in New York might be available for his purpose. Accordingly the four groups of staff which adorned the piers of the arch were taken down carefully, packed away, and in due time sent to Charleston, where the Art Palace had been specially designed to receive them. In fact, they are as effective in their new site as they were in the old.

The wings of the building are quite plain and solid walls, and against these the groups are displayed, two on each front, while the central wall is decorated with double columns flanking the three entrances. At a distance from which the incongruity of naval and military groups for the decoration of an art building is not manifest, the effect is excellent; and in any case the sculpture is a far more effective enrichment than could, with the means at hand, have been attained from anything specially devised for the purpose.

The most noteworthy piece of sculpture specially devised for the Exposition is Mr. Lopez's vigorous and expressive "negro group," which has been the subject of a very amusing and instructive controversy in Charleston. The group is simply a representation of plantation work and play.

A stalwart negress is striding forward, bearing a burden on her head, with the power and grace with which her like can be seen doing it in Charleston any day. She is flanked by the crouching figure of a blacksmith and the sitting figure of a banjo player. The Caucasian in his blindness imagined that this would be an appropriate ornament for the front of the Negro Building, and also that the colored exhibitors would be glad to have it there.

But no sooner was it in place than the colored ladies and gentlemen of the town began to rage furiously at what they regarded as an insult to their race. They even went to the length of a public indignation meeting.

No white Charlestonian seems to know what the protestants had in their minds, although it is intimated that the colored politics of South Carolina have also their color line, as those of Haiti have, the line being drawn between "persons of color" and full-blooded Africans. There is no question about the pure Africanism of these figures, as, of course, there should not be in a negro group. But, at all events, the protest has been availing, and the best piece of sculpture devised for the Exposition will be removed from the quarter of those inappreciative persons whom it was designed to honor.

Thus far we have been talking about the less conspicuous half of the fair, which includes, in addition to the things described, a race track, of which the "privileges" have already been sold for a handsome sum, and the grand stand of which has unfortunately been so placed as to cut off the most effective view of the Art Building. The other half is adjoined to this only at the corner, where are the entrance and the Administration Building, and where a year ago there was nothing to be seen but a flat and empty field.

The plaza which occupies the central space measures some 1,200 feet by 900, and more than half its length, and at one end its whole width are lined with buildings, three "palaces" and their connecting colonnades. The effect of spaciousness, which the mere dimensions would make very considerable, is enhanced by the treatment of the whole plaza as a sunken garden, with basins and fountains and tropical plants, the palmetto, of course, being especially in evidence.

It was quite inevitable that the buildings of what calls itself a West Indian Exposition should be composed largely in the "West Indian style." Of course,

that is the same style which was known as Columbian at Chicago and as Pan-American at Buffalo, the Spanish Renaissance, with special stress upon any American modification it underwent in Spanish hands. The Negro Building, for example, is a low-spreading erection that draws most of its detail from the architecture of the Missions of Texas and California.

In this principal court, the Cotton Palace almost necessarily occupies the post of honor at the rear, being flanked on one side by the Building of Agriculture and on the other by that of Commerce.

When it is mentioned that the Cotton Palace is 360 feet long and 50,000 square feet in area, that the other buildings are not very noticeably smaller, and that the curved connecting colonnades are each as long as any of the buildings they connect, it will be seen that the scheme is architecturally ambitious. And, indeed, the ambitiousness of it is very well borne out.

There is nothing like the elaborate polychromy of Buffalo, and the plastic decoration also is much less elaborate than there. But it is an architectural show very well worth seeing.

Perhaps the cupola of the Cotton Palace, by its proportions as well as by its treatment, has too much affinity with what may be called the American capitolian style to be accepted as typically Spanish Renaissance. The lower and more spreading domes of the lateral buildings seem to have greater congruity with their substructures.

But the purpose of "drawing the eye" by a lofty but, at the end of the intended vista, was a perfectly legitimate one; and the cupola does not discord with what is underneath it, while this is unmistakably and typically Spanish, the fantastic curvilinear gable with its fantastic supporting colonnade, and the massive flanking walls with the strong projection of their protecting eaves. A feature of the flanking buildings is the addition at the sides of what may be called an aisle, in continuation of the colonnades, which is a series of lunettes, separately and visibly roofed, and an effective feature it is.

Facing the Cotton Palace, at the entrance end of the plaza, is the very ample Auditorium, a semi-circle like the Greek theaters, entered at the center of the round side, and with the stage, which contains a huge organ, at the center of the flat side. There is notably clever architectural use of the cantilever in the interior, one arm projecting over the gallery, while the other supports the roof and the half-dome.

And one of the features of the buildings of the Court is the successful care that has been given to the design of the interiors, which in most exposition buildings are left as mere sheds. In the Cotton Palace the wings are round arched naves, with aisles opening into them, all as simple and straightforward as possible, as indeed, they had to be, and yet deriving effect from the study that has been given to their proportion, so that the decoration, which is to be merely a lining of textiles, will take value from the frame on which it is stretched.

The interior effect is also very good of the low, alcoved aisles of the lateral buildings, of which the exterior effect has already been noted. All these buildings are to be cream-colored, or in "old ivory," as the official term is, and to be roofed with the similitude of old red Spanish tiles.

At Buffalo the tiles were imitated with metal. At Charleston the reproduction is done in staff, and, as the models were very good, the effect is more "convincing."

Merely as an architectural display, the Charleston fair promises to be very well worth seeing. What is to be seen inside the buildings was not so visible three weeks ago.

But in one department the show promises to be a surprise to experts, and that is in the art department. Mr. Townsend, the director of this department, reports that he has discovered more examples than most Northerners imagined to exist in Charleston itself of the early American painters, of Gilbert Stuart and Copley and Sully and the Peales, and that he has discovered also gratifying evidence on the part of their possessors to lend them for the purposes of the Exposition.

But, after all, the Exposition will have served its best aesthetic purpose to the visitors from the North if it induces them to stop at Charleston and study the quaint and picturesque old city itself, less altered than any other Atlantic seaport, excepting Annapolis, from what it was in its high and palmy days. Those were the days when the good Josiah Quincy, coming from Boston, avowed that he found in Charleston more of social civilization, and especially of elegance, than he had ever seen or ever expected to see on this side of the Atlantic.

The social civilization and elegance are still there, with the added picturesqueness of antiquity, and however good the rest of the show may be, Fair Charleston is likely to be the best of the Charleston Fair.—M. S., in *The New York Times*.

COCKCHAFFERS.

MR. E. A. BUTLER, in the current number of *Knowledge*, writes as follows on this familiar insect: "Let us look at it first in its adult condition. A bulky and solid-looking creature, chestnut-colored above and black beneath, about an inch in length, with a pointed, downward bent tail, six powerful legs ending in strong hooked claws, and a pair of substantial membranous wings stowed away under two horny coverings, the whole insect dusted over with what looks like a mealy powder—such in brief is the Common Cockchafer or May Bug. The apparent mealy powder shows under the microscope as little white scale-like hairs lying side by side and pointing backward. They are more thickly strewn in some parts than in others, and the females have a particularly dense covering of them. On the breast they are replaced by a shaggy covering of long, yellowish hairs. All along each side of the abdomen, just below the edges of the wing-covers, is a row of snow-white triangular patches made of similar and still broader scales, each patch being sharply outlined and bounded by the general black surface—a striking color scheme which vastly improves the appearance of the insect and redeems it from absolute plainness. This covering of scales and hairs makes the cock-

chafers an instructive insect for illustrating the gradual change of an organ of given elemental shape into one altogether different. A careful examination under the microscope will show that even the broadest of the scales are merely expanded hairs, and from different parts of the body a selection might easily be made of all varieties of these appendages ranging from the narrowest, which would unhesitatingly be called hairs, through a series of minute modifications whose exact name would be doubtful, to what again would be unhesitatingly described as scales."

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Expositions of Automobiles, Cycles, and Sports at Brussels.—In view of the growing interest in mechanical traction, our manufacturers of automobiles, cycles, etc., may care to learn that, in the early spring, two international exhibitions of automobiles, cycles, etc., are to be held in Brussels. From the 8th to the 17th of March, 1902, an International Exposition of Mechanical Locomotion will be held in the grand hall of the palace in the Park Cinquantenaire; from the 15th to the 23d of the same month, the Tenth International Exhibition of New Locomotion (automobiles, cycles, sports, and industries connected therewith) will be held at the Pole Nord, Brussels.

In the international exposition at the Park Cinquantenaire, there is to be a section devoted to aerostatics, organized by the Aéro Club of Belgium, and under the direction of the aéronaut Mr. Capazza, who will exhibit two of his balloons, one torn and worn, accompanied by his parachute, and the other inflated. The exhibition will include every kind of known mechanical locomotion, automobile, velocipede, aérial, electric, maritime, and nautical. Trials of aérial locomotion will take place in the Park Cinquantenaire during the exposition.

As regards the disposition of eventual profits, the Belgian Syndical Chamber of Automobiles has decided to make the following division: Twenty per cent will be set aside as the nucleus of a fund; 30 per cent will be used in experiments, such as races, competitions, trials, etc.; and 50 per cent will be returned to exhibitors, who will thus share directly in the profits of the exposition and have the chance of regaining a part of the amount expended by them for space. In this way, constructors and agents may participate without incurring very great expense.—Geo. W. Roosevelt, Consul at Brussels.

Sake Brewing in Japan.—Many inquiries regarding the brewing of sake having been received at this office, I have prepared, says Consul-General Bellows, of Yokohama, the following report, which I have endeavored to make as brief as possible without omitting anything of real value. The chemical analyses given were taken from a memoir (now out of print) prepared by R. W. Atkinson, professor of analytical and applied chemistry in the Tokyo University.

Sake, the national drink of Japan, as wine is of France and beer of Germany, is manufactured almost entirely from rice, and differs from beer chiefly in having a larger percentage of alcohol and smaller proportions of dextrose and dextrin. The manufacture of sake includes two processes—the production of koji, which the sake brewer uses much as a beer brewer does malt and often prepares in independent factories, and the combination of the koji with steamed rice and water under conditions calculated to induce fermentation.

For the manufacture of koji, it is essential that a constant and rather high degree of heat should be maintained for several days; and to secure this condition, chambers are cut in the ground 15 or 20 feet below the surface, and these are approached by a long, narrow passage, entered by a shaft, so that a cold draft may not reach the working chambers.

The rice is brought to the factory husked, but not cleaned, and is placed in a wooden mortar sunk in the ground. Over the mortar is a heavy wooden hammer attached to a lever. The hammer is raised and then permitted to fall by its own weight upon the rice, causing the grains to rub upon each other, thus removing the testa and usually the embryo of the seed also. In most cases, the lever is worked by man power, but in some instances steam or water power is used. The pounded mass is separated into three portions—the whole grains, the broken grains, and the bran, only the former of which is used for the best koji. The loss in this operation varies from 25 to 40 per cent.

The whole grains are placed in a tank covered with water and occasionally trodden, the water being frequently changed. After being thoroughly washed, the grain is permitted to soak over night, and is then steamed in a large tub with a false bottom covered with cloth. This tub is placed over an iron boiler filled with water, the steam from which passes through an opening in the true bottom of the tub and permeates the mass of rice, heating the grains, killing the embryos, if any remain after the pounding, and causing the starch to become gelatinized. After this treatment the grains should be flexible, of a horny appearance, and uniform throughout. The mass, now called "moto," is spread on mats and cooled to about 29 deg. C., when a yellowish powder called "tane," and consisting of the spores of a fungus, is mixed with it in the proportion of about 3 cubic centimeters of tane to 72 liters* of rice. The spores are first thoroughly mixed with a small quantity of rice, and this mixture is scattered over the whole mass while spread out on the mats, and well stirred. The mixture is then carried to the cooler part of the underground chambers, and left for twenty-four hours, when it has a temperature of 25 or 26 deg. C. It is now placed in the innermost part of the underground chambers and spread out in a very thin layer on wooden trays. After twelve hours, the contents of each tray are collected into a little heap on the tray and left for four or five hours, during which time the temperature rises considerably, and the vegetation of the spores binds the grains of the mass together with the mycelium. To prevent overheating, it is again spread out on the tray, and after cooling a few hours brought into heaps again, and afterward worked with the hands for some time. While

in the innermost chamber, the temperature of the koji varies from 15 to 27 deg. C., and the air in the chamber from 8 to 13.8 deg. C. The highest degree of temperature in the koji is observed just before the masses are broken apart, and the lowest just before making up into heaps again. The chamber is not artificially heated, except at starting, after being disused for some time. The heat generated by the growing fungus is sufficient to maintain the temperature of the room, besides heating the rice, although the consumption of oxygen and generation of carbonic-acid gas make it necessary to ventilate the room; and a current of warm air is constantly rising through a shaft at the front end of the passages, and being replaced by a current of pure, cold air, which flows along the floor of the chambers. In winter, when the difference between the outdoor temperature and that in the chamber is considerable, this method of ventilation is found effective and satisfactory; and during the warmer part of the year the koji is manufactured in small quantities only, and the ventilation is of less consequence.

The following table shows the chemical composition of two specimens of koji, A and B, which, before being analyzed, were dried at 100 deg. C. In drying, the specimens lost, respectively, 25.82 and 28.1 per cent of their weight.

Description.	A.	B.
	Per cent.	Per cent.
Dextrose	25.02	58.1
Dextrin	3.88	4.41
Albumenoids:		
Soluble	8.34	6.4
Insoluble	1.5	1.83
Ash:		
Soluble	.52	.54
Insoluble	.09	.04
Starch	56	26.02
Cellulose	4.2	1.94
Fat	.43	.5
Total	99.98	99.96

Steamed rice, koji, and water are now mixed in the proportion of 90 liters of rice, 36 of koji, and 108 of water, the numbers for rice and koji referring to the amount of dry rice needed to produce the quantity used, as will also be the case in the formulae given later in this report. After mixing, this mass is divided into six parts, so as to be more easily handled; each is placed in a shallow wooden tub and worked by hand for two hours, care being taken to break the lumps and render the mass of a smooth, even consistency. It is left for twenty-four hours, then stirred with paddles, and the different lots are emptied together into a larger tub, which has a wooden lid and is covered with matting to hinder the escape of heat. At this point in the preparation the treatment varies, some permitting it to stand for five or six days, while others proceed at once with the heating, which is the next step in the process.

A chemical analysis just before heating showed:

	Per cent.
Dextrose	12.25
Dextrin	5.69
Glycerin, ash, albumenoids, etc.	.48
Fixed acid	.019
Volatile acid	.008
Water (by difference)	81.553
Total	100

Specific rotary power	degrees	106
Specific gravity		1.18
Temperature	degrees	10
Starch, undissolved	per cent	15.46

A tub 18 inches deep and with a diameter varying from 12 inches at the top to 9 inches at the bottom is filled with boiling water, tightly closed, and suspended in the mash in the large tub, where it is frequently moved about, so as to agitate the mash and bring all parts in contact with the heater. This is usually left for half a day and then replaced by a fresh one, from five to ten tubs, or in some breweries even more, being used. During this process, the liquid attains a temperature of 23 deg. C., or a little more, and the heat induces alcoholic fermentation. After seven days, the liquid is transferred to the shallow pans and permitted to cool until the fourteenth day, when this stage of the manufacture is completed, and the substance, now called "moto," has a temperature of about 9 deg. C. Its chemical analysis shows:

	Per cent.
Alcohol	10.5
Dextrose	.2
Total acid	.56
Starch and cellulose	16.58
Water (by difference)	72.16
Total	100

The process of fermentation resembles that of wine in the fact that no ferment has been knowingly added by the brewer, and the question of the origin of the ferment, which develops very suddenly after heat is applied, has given rise to some discussion among scientists. The sake brewer judges of the progress of the moto by the activity of fermentation and the taste of the liquid, and uses it in the subsequent process much as yeast is used by the beer brewer.

Two hundred and thirty-four and one-half liters each of moto, steamed rice, and water are now mixed with 63 liters of koji in a large tun, and the mixture is stirred every two hours. After forty-two hours to three days, the workman adds 360 liters of steamed rice, 117 1/4 liters of koji, and 541 liters of water; it is divided into two parts, and the stirring is continued every two hours. After twenty-four hours, steamed rice, koji, and water are again added in nearly the same proportion to the whole amount as before, the quantity of water depending upon the alcoholic strength desired. At first, the liquid is divided among four receptacles, but after three days it is gradually collected into one large vessel, in which the fermentation goes on more vigorously for two or three days, and then lessens, the froth sinks, and after a few more days the product is ready for filtration.

The liquid now consists principally of alcohol and

water, with a small quantity of the unaltered rice grains suspended in it. It is put into long, hempen bags, which have been strengthened by being soaked in the juice of unripe persimmons. Each bag is filled about two-thirds full, fastened securely, and three or four hundred are placed in a press—a wooden box, furnished with an aperture below and covered by a wooden plate, which fits inside the box and is pressed down by a lever. A slight pressure is applied and gradually increased to 1,200 or 1,800 pounds; and after twelve hours the cover is removed, the bags are turned over, and are again subjected to pressure for twelve hours. The composition of the filtered liquid is:

	Per cent.
Alcohol	11.14
Glycerin, resin, and albumenoids	1.992
Fixed acid	.13
Volatile acid	.02
Water (by difference)	86.718
Total	100

The analysis of the residue is as follows:

	Per cent.
Soluble solid matter	1.43
Starch and cellulose	32.07
Ash	.7
Alcohol	.6
Water	59.8
Total	100

The alcohol in the residue is afterward extracted by distillation. The filtered sake is still turbid, and is cleared by being permitted to stand until the suspended matter has settled, when the top is drawn off. The clear sake thus secured would not keep for more than a few days in warm weather, and before being stored it is heated to a temperature of from 49 to 54 deg. C., and then, while still hot, transferred to the store vats, large tuns holding about 7 kiloliters. These are closed with lids and sealed by pasting a strip of paper over the joint. Even with these precautions, it is necessary to examine the sake frequently in warm weather, and when any signs of alteration are apparent it must be reheated. Because of the difficulty of preservation, the whole of the winter's brewing is consumed within the year, even in the large breweries.

Pavements in Glasgow.—In response to inquiries received on the subject from time to time from American firms, a brief account of the method of street paving adopted in this city is given below.

The material mainly used is granite and whinstone, these being Scottish productions. This material is found to be the most durable; but, in consequence of the excessive noise its use creates, the corporation has for some time been experimenting with smooth paving of different kinds, such as tar macadam, alcatraz, and seyssel. Tar macadam is supplied by a Scotch firm, alcatraz by an American firm, and seyssel by an English firm. These three are of a somewhat similar nature, although the compositions seem to differ. During the present year, 22,228 square yards of street were laid with these materials, in the following proportions: Tar macadam, 17,951 yards; seyssel, 2,283 yards; alcatraz, 1,994 yards. Three streets not included in the above figures are being laid with alcatraz. The opinion has been expressed that the result of the experiments, so far, shows that the seyssel promises best. The alcatraz has been described to me as very satisfactory, but not so good for wear as the English material; however, as the materials are in the experimental stage, an opinion as to their respective merits can hardly be ventured as yet. The American article is the cheaper of the two, and the prices of both include maintenance for ten years.

The climatic conditions here appear to seriously affect these forms of smooth pavement. Both American and Scotch firms have at times attributed failure of their work to this cause. The pavement seems to give way readily if there is a heavy rainfall, the result being that the surface soon becomes broken. Suitable provision for this would have to be made. Probably, the best time to commence operations would be in the spring or summer, when the rainfall might reasonably be expected to be at its lowest, and the climatic conditions, in general, better.

Paving with wood has not been viewed here with much favor. It has already been tried to some extent in Glasgow, but is entirely absent from the present experiments.—Samuel M. Taylor, Consul at Glasgow.

New Gold Fields in French Guiana.—Consul Moulton, of Demerara, reports, December 18, 1901, that he has been advised by the consular agent at Cayenne that the rich placer gold diggings in the Inini River district of French Guiana are attracting many prospectors to that locality. During October and November last over 2,000 pounds of gold were brought down to Cayenne, and, according to the agent, other large lots will soon follow. The consul adds that, in view of the great number of foreigners who may be attracted to the colony, the government has passed an ordinance requiring passports from such persons before they are permitted to land.

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No. 1260. February 8.—Commercial and Economic Conditions in Mexico.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

*1 centimeter = 0.39 inch; 1 liter = 0.908 quart.

TRADE NOTES AND RECEIPTS.

To Paste Paper Signs on Metal or Cloth.—According to Jenke, gutta percha paper is excellently adapted for this purpose. A piece of the same size as the label is laid under the latter and the whole is heated. If the heating cannot be accomplished by means of a spirit lamp the label is ironed down under a protective cloth or paper in the same manner as woollen goods are pressed. This method is also very useful for attaching paper labels to minerals.—Apotheker Zeitung.

Dr. Gaucher's Corn Cure.

Resorcin	1
Salicylic acid	1
Lactic acid	1
Colloidum elasticum	10

Paint the corn daily for 5 or 6 days with the above solution and take a foot-bath in very hot water. The corn will readily come off.—Journ. Med. Interne.

Waterproof Glue.—In a liter of rectified alcohol dissolve 60 grammes of sandarac and as much mastic, whereupon add 60 grammes of white oil of turpentine. Next, prepare a rather strong glue solution and add about the like quantity of isinglass, heating the solution until it commences to boil; then slowly add the hot glue solution, till a thin paste forms, which can still be filtered through a cloth. Heat the solution before use and employ like ordinary glue. A connection effected with this glue is not dissolved by cold water and even resists hot water for a long time.—Die Werkstatt.

Practical Tests for the Preservation of Fruit by Cold.—The constructors of a French freezing machine have conducted tests on the preservation of fruits and vegetables by cold. The cooling is accomplished by the condensation of vapors of sulphurous acid anhydride. Experiments were carried out with pears, plums, bananas and melons in various stages of ripeness. Of special interest is the behavior of such products as show a rapid decomposition upon complete ripeness, as, for instance, melons. Perfectly ripe melons, placed in the refrigerator and left therein for eight days at a temperature of +1 to +4 deg. C., kept perfectly and did not change their taste.

Hence it has been proven that at the said temperature the ripening of the fruits is perfectly arrested and that they undergo no changes.—Neueste Erfahrungen und Erfahrungen.

Production of Effervescent Salts.—Granulated effervescent salts are produced by heating mixtures of powdered citric acid, tartaric acid, sodium bicarbonate and sugar to a certain temperature, until they assume the consistency of a paste, which is then granulated and dried.

If effervescent caffeine citrate antipyrin, lithium citrate, etc., are to be prepared, the powder need not be dried before effecting the mixture, but if sodium phosphate, sodium sulphate or magnesium sulphate are to be granulated, the water of crystallization must first be removed by drying, otherwise a hard, insoluble and absolutely non-granular mass will be obtained. Sodium phosphate must lose 60 per cent of its weight in drying, sodium sulphate 56 per cent and magnesium sulphate 23 per cent.

Naturally, water and carbonic acid escape on heating and the loss will increase with the rise of temperature. For the production of the granulation mass it must not exceed 70 deg. C. and for drying the grains a temperature of 50 deg. C. is sufficient.

The closeness of the sieve should vary according to the necessary admixture of sugar and the size of the grains.

If the ingredients should have a tendency to cling to the warm bottom, one should endeavor immediately upon the commencement of the reaction, to always cause new portion of the surface to come in contact with the hot walls.

When the mass of the consistency of paste is then pressed through a wire sieve, paper or a fabric is placed underneath; afterward dry at sufficient heat. For wholesale manufacture, surfaces of large size are employed, which are heated by steam.

In the production of substances containing alkaloids, antipyrin, etc., care must be taken that they do not become colored. It is well, therefore, not to use heat, but in place of that to allow the mixture to stand in a moist condition for 12 hours, adding the medicinal substances afterward and kneading the whole in a clay receptacle. After another 12 hours the mass will have become sufficiently paste-like, so that it can be granulated as above.

According to another much employed method, the mass is crushed with alcohol, then rubbed through a sieve and dried rapidly. This process is somewhat dearer, owing to the great loss of alcohol, but presents the advantage of furnishing a better product than any other recipe.

Effervescent magnesium citrate cannot be very well made; for this reason, the sulphate was used in lieu of the citrate. A part of the customary admixture of sulphate was replaced by sugar and aromatized with lemon or similar substances.

In order to impart a raspberry or currant flavor, etc., to the effervescent mass, the latter must be well saturated with it, before heating, and should be evenly dyed, if necessary. Although a portion of the flavor is lost, the mass remains impregnated with the larger part of it.

An excellent granulation mass is obtained from the following mixture by addition of alcohol:

Sodium bicarbonate	300
Tartaric acid	150
Citric acid	135
Sugar	300

The total loss of this mass through granulation amounts to 10 to 15 per cent.

To this mass, medicinal substances, such as antipyrin, caffeine citrate, lithium citrate, lithium salicylate, phenacetin, piperacrin, ferric carbonate, pepsin may be added, as desired.

In order to produce a quinine preparation, use tincture of quinine instead of alcohol for moistening; the quinine tincture is prepared with alcohol of 96 degrees.—Pharmaceutische Centralhalle.

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